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1791 - ENVIRONMENTAL ANALYSIS

WESTERN ENERGY COAL LEASE MODIFICATION BLGS 020989-038770

ENVIRONMENTAL ANALYSIS RECORD

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United States Department of Interior - Bureau of Land Management

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1	LITERATURE CITED
2	EXISTING ENVIRONMENT
3	ANALYSIS OF IMPACTS
4	PUBLIC INVOLVEMENT

SUMMARY

Colstrip, Montana, has been a coal strip mining area for over 50 years. Western Energy Company owns the town and most of the coal leases and is currently mining in Areas A and E. Area A encompasses about 3,800 acres in which approximately 2,000 acres have been leased from private owners or the Federal Government. Western Energy Company proposes to modify the existing Federal coal lease in Area A to include an additional 320 acres in their mining operation.

This Environmental Analysis Record (EAR) indicates that mining on the 320 acres in Area A would provide only limited additional environmental impacts beyond those already occurring due to the present mining activities. The proposed lease modification would facilitate a more efficient and practical mining and reclamation plan and would prevent loss of coal within a mined area. This is referred to as a loss of coal because present and foreseeable mining economics may not permit a later return to mine the bypassed coal after the surrounding areas have been mined and reclaimed.

Of the 320 acres in the proposed lease modification, a previous BLM land use plan recommendation has been made that 120 acres should not be mined. Until the land use recommendation can be re-examined and given public review, it is recommended that at least this 120 acres be deleted from any lease modification.

320 acres in their mining operation.

This Environmental Analysis Record (EAR) indicates that mining on the 320 acres in Area A would provide only limited additional environmental impacts beyond those already occurring due to the present mining activities. The proposed lease modification would facilitate a more efficient and practical mining and reclamation plan and would prevent loss of coal within a mined area. This is referred to as a loss of coal because present and foreseeable mining economics may not permit a later return to mine the bypassed coal after the surrounding areas have been mined and reclaimed.

Of the 320 acres in the proposed lease modification, a previous BLM land use plan recommendation has been made that 120 acres should not be mined. Until the land use recommendation can be re-examined and given public review, it is recommended that at least this 120 acres be deleted from any lease modification.

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

Western Energy Company is proposing to modify an existing coal lease for mining 320 additional acres of federal coal within what is referred to as Area A, (approximately 3,800 acres) at Colstrip, Montana. This analysis examines and records the possible impacts that may result if the Bureau of Land Management (BLM) leases the coal. Physical and biological impact analyses are for the most part limited to Area A, but air, water, and socio-economic factors are analyzed on a broader scale.

The previously leased Area A is part of a larger complex of coal mines and power generation plants, which are to be the subject of a regional environmental impact statement. In the meantime, a specific analysis on the 320 acres within Area A is necessary because a decision must be made before Western Energy Company can submit their July 1, 1976 mining plan to the State of Montana. Consequently an immediate decision by the BLM and Department of the Interior is mandatory. Otherwise the coal will be bypassed, the area will still be impacted by surrounding coal mining, and the coal may be committed to non-use because it may not be economically feasible to mine the bypassed coal in the foreseeable future.

HISTORY AND BACKGROUND

Includes lease mod.

The effective date of the original coal lease (BILLINGS 020989-038770) was May 5, 1923. The lease was to the Northwest Improvement Company, a subsidiary of the Northern Pacific Railroad. The entire lease includes Areas A, B, C, D, E, and F; but Area A is the only portion proposed to be modified.

The Northwest Improvement Company began mining coal in the Colstrip area in 1924. The coal was used as fuel for railroads in Montana and North Dakota. The coal was strip mined, and the seam which was mined was the Rosebud (the coal seam closest to the surface). Original production was 3,300 tons per day.

Several other small mine operations were reported in the Forsyth-Colstrip area during 1929. Most of the coal from these mines was used by local ranchers for domestic consumption. Mining was usually done by blasting coal off the face of exposed outcrops, but several openings were also made into lower coal seams.

During the 1940's and up until 1958, coal production declined. This decline can be attributed to increased competition from other sources of fuel, such as oil and other liquid fuels, and from natural gas and hydroelectric power.

By 1969, the trend reversed when it was determined that coal could be mined by large scale, low cost, stripping methods, and that it could compete successfully with other low cost energy sources.

The Northwest Improvement Company mined approximately 44 million tons of coal during 35 years (1924-1958) of operation at Colstrip. No effort was made to reclaim spoils. Burlington Northern Railroad, the successor of Northern Pacific, has begun reclamation on these old spoils in recent years.

In 1959, the Montana Power Company acquired the large mining machinery, the townsite of Colstrip, and all of the mining leases previously held by the Northwest Improvement Company. This included Federal lease BILLINGS 020989-038770.

In 1966, Western Energy Company incorporated as a subsidiary of the Montana Power Company, and resumed coal production in 1968.

FEDERAL ACTIONS INVOLVED

On the basis of this Environmental Analysis Record, the BLM Miles City District Manager must recommend whether or not an Environmental Impact Statement (EIS) is to be prepared. This recommendation is made to the BLM State Director, BLM Director in Washington, D. C., and Department of the Interior officials.

If an EIS is not recommended, the District Manager uses this Environmental Analysis Record and a Technical Examination in accordance with part 43 Code of Federal Regulations to recommend favorable or unfavorable action on the lease modification. If the recommendation is favorable, stipulations are prepared for the proposed lease modification and forwarded to the BLM State Director.

The U.S. Geological Survey reviews the stipulations, and any technical conflicts are resolved prior to forwarding to the BLM in Washington, D. C. The lease is forwarded to Department of the Interior officials for final action.

APPLICANT'S PROPOSED ACTION

Location

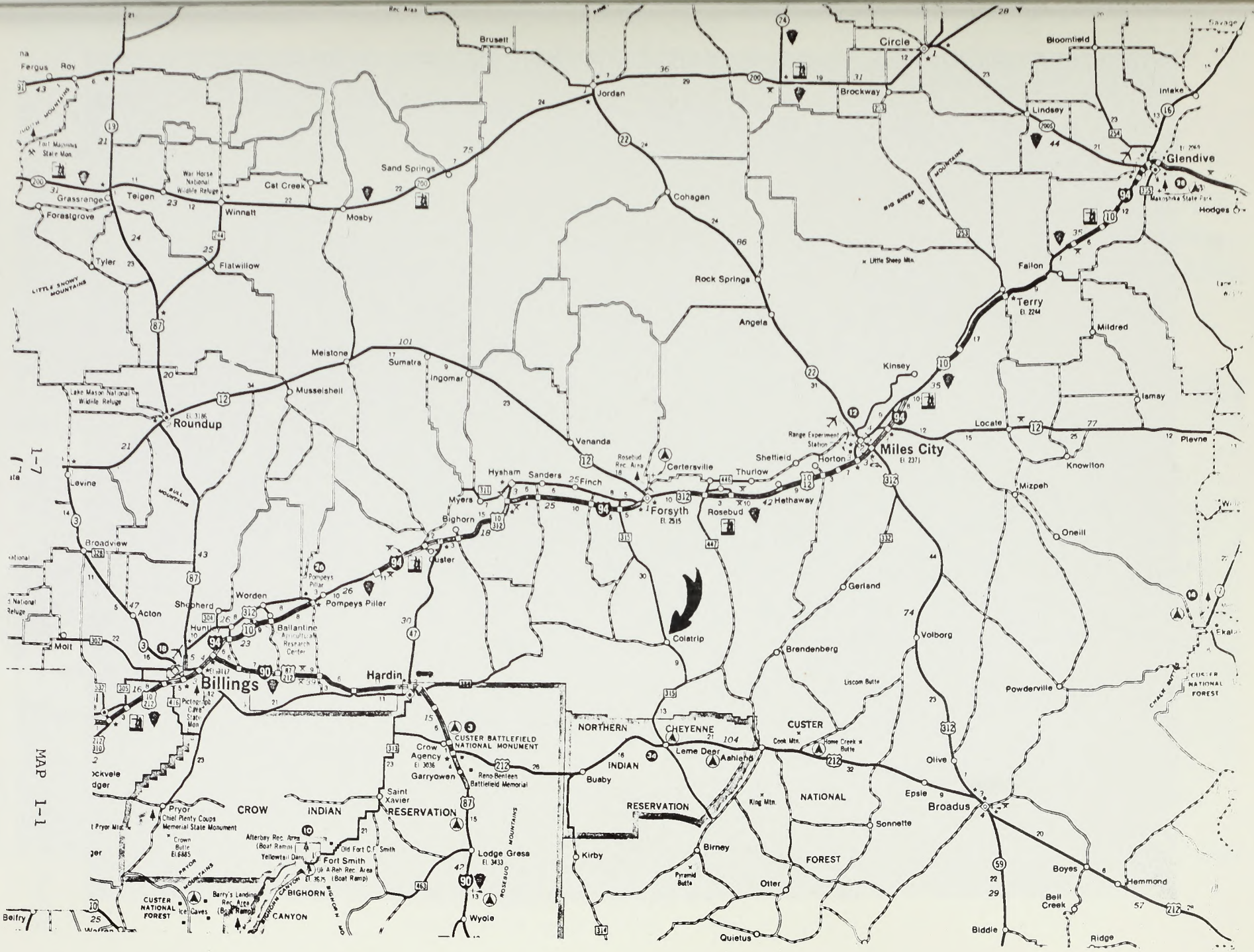
Area A lies immediately west of Colstrip, Montana (Photo 1-1). Colstrip is located 29 miles south of Interstate 94, and 36 miles from Forsyth, Montana. (See Map 1-1.) The proposed lease modification is approximately one mile west of Colstrip, in the E½ of Sec. 32, T. 2 N., R. 41 E. (see Fig. 1-1 and Photo 1-2).

Project Objectives, Need, and Time Frame

The coal presently mined from Area A is exported from Montana. Coal mined as a result of the proposed modification of Area A would also be exported. The coal is moved by rail to Minneapolis, Minnesota and Madison, Wisconsin. Wisconsin Power and Light, and Northern States Power use it to generate electrical power. Current production in Area A is 4.2 million tons per year.

Western Energy's schedule calls for mining coal in the proposed modified portions of Area A by July, 1976 (see Fig. 1-2). This action meets the Secretary of Interior's Short-Term Criteria #2 for coal leasing (that the coal will be needed for production in the near future). If the proposed modification of the lease is not approved, the mining company will change their present plans and bypass this portion of the federal coal.

PHOTO 1-1. Over-view of the Colstrip vicinity. Western Energy Mining Area A in mid-center picture.


Fergus
Roy
Brusett
Jordan
Circle
Brockway
Bloomfield
Intake
Lindsey
Glendive
Hodges
Grassrange
Forestgrove
Teigen
Winnett
War Horse National Wildlife Refuge
Cat Creek
Sand Springs
Mosby
Cohagen
Tyler
Flatwillow
Rock Springs
Angela
Fallon
Terry
Mildred
Meistone
Sumatra
Ingomar
Musselshell
Roundup
Kinsey
Ismay
Locate
Pleve
Venanda
Range Experiment Station
Miles City
Knowlton
Certersville
Shettield
Horton
Thurlow
Hysham
Sanders
Finch
Myers
Forsyth
Rosebud
Hethaway
Mizpeh
Bighorn
Custer
Oneill
Broadview
Pompeys Pillar
Worden
Shepherd
Acton
Huntley
Ballantine
Molt
Billings
Hardin
Colstrip
Gerland
Brendenberg
Volborg
Liscom Butte
Powderville
CUSTER BATTLEFIELD NATIONAL MONUMENT
Crow Agency
Garryowen
Reno-Benteen Battlefield Memorial
NORTHERN
CHEYENNE
CUSTER
Leme Deer
Ashland
Cook Mtn.
Home Creek Butte
Olive
Epsle
Broadus
Buaby
INDIAN
RESERVATION
King Mtn.
NATIONAL
FOREST
Sonnette
Saint Xavier
Pryor
Chief Plenty Coups Memorial State Monument
CROW
INDIAN
RESERVATION
Afterbay Rec. Area (Boat Ramp)
Yellowtail Dam
Old Fort C.F. Smith
Fort Smith
Lodge Grass
Kirby
Birney
Pyramid Butte
Otter
Boyes
Hemmond
Bell Creek
Biddle
Ridge
Quietus
Wyole
CUSTER NATIONAL FOREST
Ice Caves
Barry's Landing Rec. Area (Boat Ramp)
BIGHORN
CANYON
Belfry
Little Sheep Mtn.
Big Sheep Mountains
Little Snowy Mountains
Bull Mountains
Pryor Mountains
Rosebud Mountains
Chalk Butte
Lake Mason National Wildlife Refuge
Rosebud Rec. Area
Pompeys Pillar
Ekalaka
Maxinshke State Park
Fort Maginnis State Mon.
Pictograph Cave State Mon.

1-7

MAP 1-1

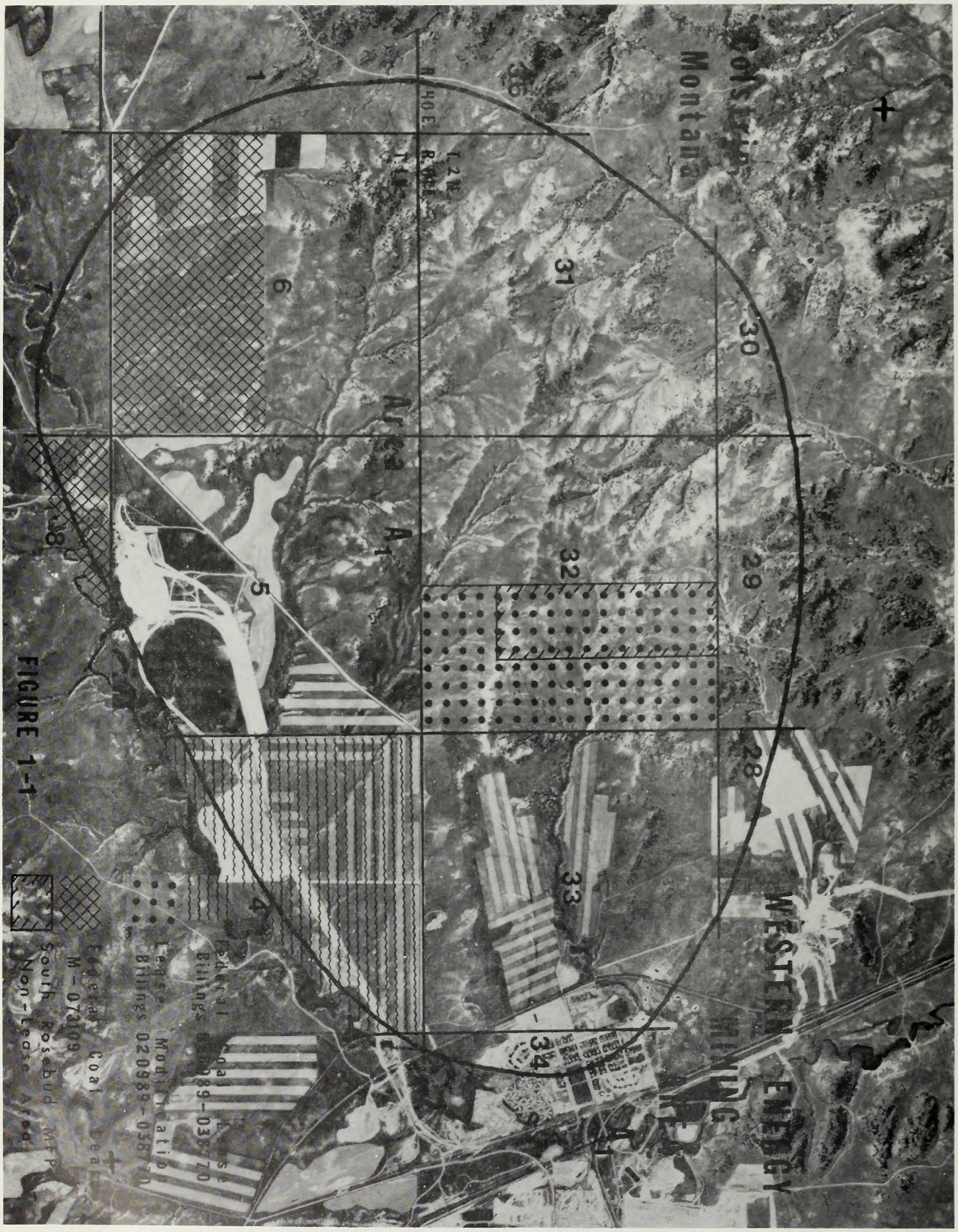

Colstrip
Montana
WESTERN ENERGY
MINING
Area A-1
T.2N.
R.40E.
T.1S.
R.41E.
36
31
30
29
28
33
32
6
5
4
1
7
18
34
3
Lease Modification
Billings 020989-038170
Federal Coal Lease
M-07009
South Rosebud MFP
Non-Lease Area

FIGURE 1-1

PHOTO 1-2. Western Energy Mining
Area A (dotted line) and the E½ of
Section 32 (solid line) - Colstrip, MT.

N

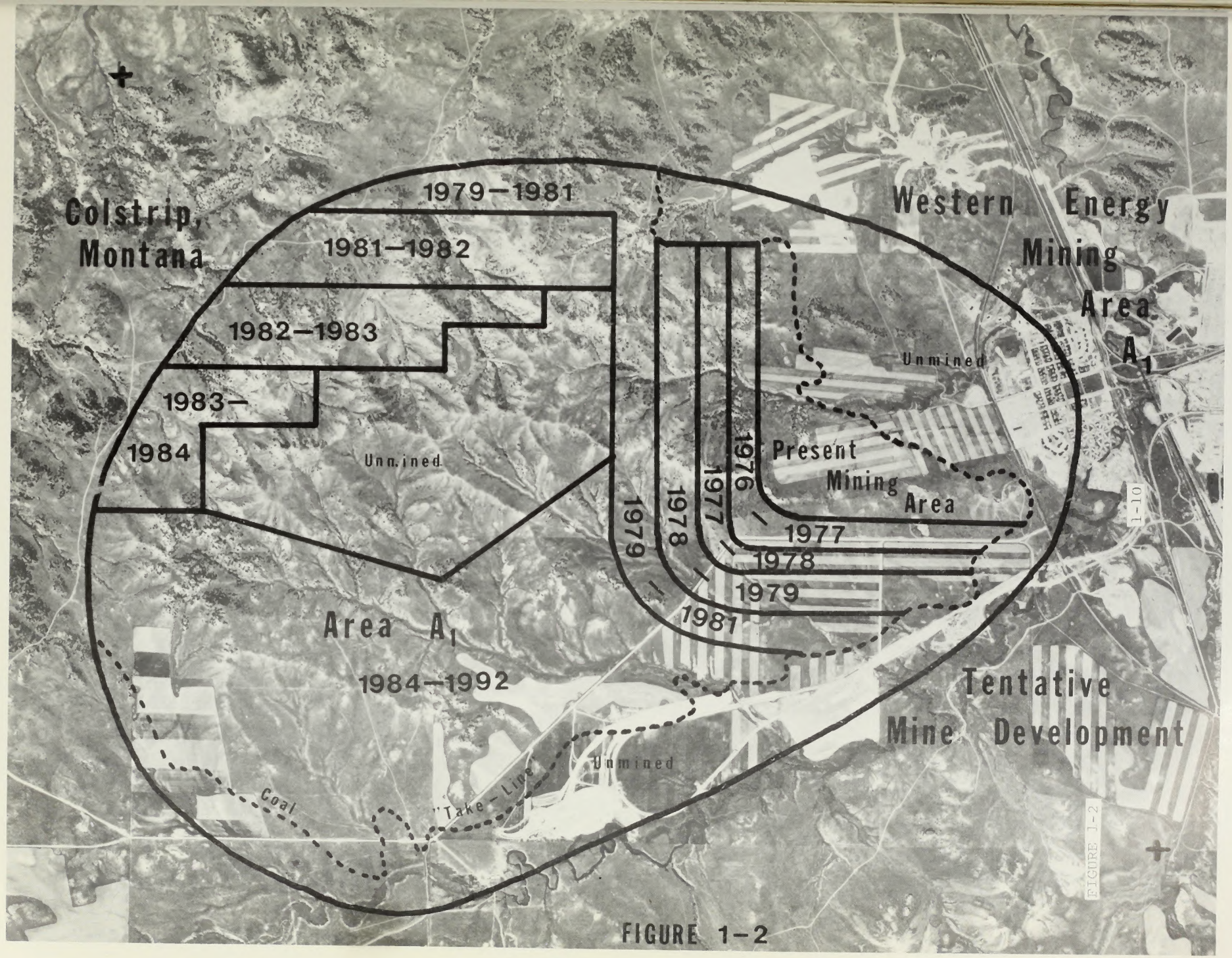

Colstrip, Montana
1979—1981
1981—1982
1982—1983
1983—
1984
Unmined
Area A_1
1984—1992
Coal
"Take-Line"
Unmined
1979
1978
1977
1976
Present Mining Area
1977
1978
1979
1981
Unmined
Western Energy Mining Area A_1
Tentative Mine Development
1-10
FIGURE 1-2

FIGURE 1-2

If the lease modification is granted, this mining would begin in 1976 and be completed by late 1981. Reclamation would take an additional five years. The area disturbed in 1976 would be reclaimed by 1981, and by 1986 (within five years of the removal of the last coal) the area last disturbed would be reclaimed. All reclamation must satisfy Federal and State regulations.

Stages of Implementation and Discrete Operations

The mine site preparation and all processing facility construction for the existing lease are completed for the on-going mining operation. Consequently, mining and reclamation are the only stages of implementation analyzed for the proposed modification within Area A. These stages contain several discrete operations which, even though described separately, may be occurring simultaneously.

Mining

Removal and Stockpile of Topsoils. Topsoils would be removed in two steps. The first step is the removal of topsoil by heavy equipment. The topsoil is transported and stockpiled for later use in reclamation. The second step is the removal of subsoil. The subsoil is transported and stockpiled separately from the topsoil in order to reduce the mixing of topsoil and subsoil when respread during reclamation.

Wind and water erosion of the stockpiles may be controlled by proper shaping, positioning, and seeding. The seeding composition must be approved by the BLM District Manager and State Land Department.

Removal of Remaining Overburden. The remaining overburden (all materials between subsoil and coal seam) would be removed with an electric powered, 60 yard dragline with a 325 foot operating radius (Photo 1-3).

The overburden would be piled in a pit left earlier on private land to the east. Each succeeding cut's overburden would be placed in the immediately preceding trench. The cuts begin in the SE corner of Section 33 adjacent to a buffer strip next to Armells Creek, proceed west for approximately one mile, then turn north for approximately one mile. The pattern is then reversed. The resulting pattern is a flat "V" or "U" shaped series of cuts and piles. Overburden removal would continue 24 hours a day. A grader or bulldozer would follow the dragline and remove loose clay from the top of the coal seam.

Blasting, Excavation and Loading. The exposed coal seam would be progressively drilled and blasted using ANFO (ammonium nitrate-fuel oil mixture). A 17½ yard, electric, coal-loading shovel would excavate the broken coal and load it into 120 ton, diesel powered, coal haulers.

Wedge shaped sections of coal, called fenders, paralleling the overburden side of the stripped bed, would not be mined because they prevent the spoil from caving back into the pit. Also, a four to six inch thick layer of coal would be left on the pit floor to reduce the possibility of contamination from floor rock.

Transportation, Delivery and Crushing. The coal would be transported from the pit, up a 7% grade ramp road, and out to unpaved haul

PHOTO 1-3. Western Energy Company's coal strip mining operations on Section 33 of mining Area A.

roads. It would then be moved to coal preparation facilities in the south ½ of Section 5, T. 1 N., R. 41 E., in Area A. It would be dumped, crushed into pieces of less than one and one-half inches, and loaded on rail cars or stockpiled for future loading.

Reclamation

Reclamation would include three discrete operations:

Regrading. The overburden piles would be regraded to a level or gently rolling form. Regrading usually occurs two or three spoilpiles behind the mining operation. The final cut normally has little overburden put back into it. The high wall above the final cut would be graded to blend with the adjacent terrain.

Topsoiling. Following regrading, subsoil is respread on the regraded overburden. Topsoil is then replaced and spread on top of the subsoil. The topsoiling operation would be performed by large wheeled tractor-scrapers during dry seasons of the year to prevent loss of material.

Seeding. The seeding operation involves site preparation (such as contour plowing), and re-seeding to native vegetation. This may include the use of a bulldozer, but normally would be done by farm implements.

REQUIRED MITIGATING MEASURES

All existing Federal and State laws and regulations pertaining to coal strip mining would apply.

The following standard minimum mitigating measures are stipulated in the current lease (additional and more specific mitigating measures will be developed as a result of the findings in this report):

1. Harmful overburden which could jeopardize reclamation shall be buried at a minimum depth of eight feet below the surface.
2. Soil material to be used in reclamation shall be removed and stockpiled, or placed directly on areas that have been mined and prepared for reclamation. Soil material which will be stockpiled for more than one year shall be seeded. Protective measures, such as orientation of stockpiles and reduced stockpile slopes, shall be taken to prevent soil loss to wind and water erosion.
3. Coal slack shall be buried in accordance with other toxic or harmful overburden (see 1 above).
4. All spoils must be graded to the approximate original land topography.
5. Following regrading, the Company, the surface owner, State Lands Department, and BLM representatives shall collectively determine areas to be reclaimed to native conditions and/or cultivation.

permanently sealed when the need for the drill hole no longer exists.

17. All existing improvements, including but not limited to gates, cattleguards, roads, trails, pipelines, bridges, public land survey monuments, and water development and control structures, shall be replaced, restored, or appropriately compensated for as soon as practicable in the event they are damaged or destroyed by company operations.

18. Surface buildings, supporting facilities, haul roads, and other structures that have served their purpose shall be removed and the area shall be graded and revegetated.

19. Flowing springs, wells, and reservoirs which are eliminated by mining shall be replaced with wells drilled into deeper aquifers.

20. If an archaeological or historical site is discovered during mining, operations shall immediately cease and the BLM District Manager and other appropriate authorities shall be notified. A reasonable time will be allowed for evaluation or removal.

21. The lessee will be required to comply with all State laws and regulations concerning coal mining, including laws and regulations pertaining to the protection and reclamation of surface resources, and the protection of the land, air, and water environment, where applicable.

RELATIONSHIPS WITH OTHER PROJECTS

Other projects presently taking place at Colstrip include mining in Area E by Western Energy Company, and the construction of an additional strip mine immediately south of Armells Creek in T. 1 N., R. 41 E. Two coal-fueled generating plants have been constructed immediately east of Colstrip. A proposal to construct two more generating plants at the same location is under litigation.

Western Energy has plans for mining in Areas A, B, C, D, E, and F. Coal from Area A and Area B (located south of Area A) will be exported. Coal from Area C (westward up Armells Creek) will be used for export when Areas A and B have been fully mined. The two existing power generating plants will use coal from Area E (south of Colstrip). Later, coal for the plants will be supplied from Area D. If the two additional power plants are approved and constructed, they also will obtain their coal from Areas E and D. The coal in Area F is reserved for future commitment.

Table 1-1 reflects the relationships of the various areas.

Table 1-1

Bed	Area	Total In-Place Reserves (000)	Total In-Place Strippable Reserves Under 150 Ft of Overburden (000)	Total Recoverable Reserves (94% of In-Place Strippable Reserves) (000)	Acres by Strippable Reserves
Rosebud	A	130,723	108,936	102,400	2,670
Rosebud	B	133,620	102,816	96,647	2,520
Rosebud	C	272,462	205,020	192,719	5,025
Rosebud	D	142,229	139,332	130,972	3,415
Rosebud	E	52,550	39,576	37,201	970
Rosebud	F	356,474	225,877	212,325	5,654
TOTAL		1,088,058	821,557	772,264	20,254

Note: Reserves for Areas A-E calculated on basis of 1700 tons/acre foot Rosebud thickness at 24 feet. Thickness for Area F at 23.5 feet. McKay at 8 feet.

In addition to Western Energy's operation at Colstrip, Peabody Coal Company (Big Sky Mine) is presently mining approximately four miles south of the Colstrip area. Their operation began in the fall of 1968 with a test pit. Production began in September, 1969.

Both Western Energy and Peabody are mining the Rosebud seam. Peabody also has a market for McKay coal (the seam below the Rosebud seam) which has a higher sulfur content.

RELATIONSHIP TO LAND USE PLANS

No local or state land use plans have been put into effect in the Colstrip area.

The Bureau of Land Management's Management Framework Plan for the South Rosebud Planning Unit (of which Colstrip is a part) recommended that 120 acres (W½NE¼, NW¼SE¼, Sec. 32, T. 2 N., R. 41 E.) of the proposed 320 acre lease modification proposal should not be leased because when compared to adjacent land (1) the soils were considered to be potentially more erodible, and (2) vegetation was considered to be more significant as an aesthetic forested wildlife habitat in a prairie setting. These broad recommendations were appropriate within a large general plan. However, any specific proposal requires a more detailed analysis, such as is being done in this Environmental Analysis Record.

ALTERNATIVES

An alternative to the proposed action is to deny the proposed lease modification, bypass the coal in the 320 acres of Area A, and continue the mining of the 2,000 acres already leased in Area A. This alternative will be referred to as "Continuation of Mining Without Lease Modification," throughout the analysis in this document.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

NONLIVING COMPONENTS

Air

Climate

Climate is the interaction of temperature, precipitation, humidity, wind velocity and direction, atmospheric pressure, solar and terrestrial radiation, and snow cover. Colstrip is located close to the geographic center of North America and has a modified continental climate with annual, daily, and day to day changes; light and irregular precipitation; low relative humidity; high amounts of sunshine; and constant air movement.

Air Movement. The Rocky Mountains, west of Colstrip, act as a modifying barrier to the eastward flow of frontal systems, causing greater precipitation on western slopes and less precipitation eastward.

Air masses originating in the polar area and in the Gulf of Mexico are not modified by barriers, thus they easily overflow the area. Since they originate from vastly different sources, they cause frequent and rapid changes in the weather.

Southeastern Montana, and specifically Colstrip, has a prevailing eastward air flow aloft; however, the major east-west storm track across the U.S. passes through the center of the state. This also affects the Colstrip area (Montana Department of Health and Environmental Science, March, 1973). (See Appendix 2, Fig. 1 for Colstrip Wind Rose.)

Temperature. Normal Colstrip temperatures range from a mean of 21.6°F. in January, to 72.6°F. in July. The annual average temperature is 44.1°F. Extremes for Colstrip are not available for the last 30-year reporting period, but in Billings (128 highway miles west of Colstrip) the record coldest day of -26°F. occurred in January 1963. The warmest was 105°F. in July 1960. At Miles City (76 miles northeast of Colstrip) the record coldest day was -37°F. in January 1969. The warmest was 110°F. in August 1949.

The record extreme high in Billings was 112°F. in July 1901, and the record coldest was -49°F. in February 1899. In Miles City the same extremes were 111°F. in July 1901 and -49°F. in February 1899 (Cordell, 1971). Appendix 2, Figure 2 shows monthly distribution of precipitation and temperatures at Colstrip.

Freeze Data. Freeze data for the Colstrip area is lacking. However, Forsyth (35 miles to the north) has a record of freeze data which is similar, even when considering elevational differences. Over 20 years, the mean number of frost free days at Forsyth was 130 days. The mean date of the last spring occurrence of a freeze temperature of 32°F. is May 5. The mean date of the first fall occurrence of a freeze temperature is September 26 (Cordell, 1971). The frost free period may not be synonymous with the length of the growing season, but it is a close approximation.

The topography of the area has much to do with where and when the first frost occurs. Cool air flows downhill, and collects in depressions. This causes frost to occur earlier in the valleys than in the adjacent

high grounds. Thus, the high ground in the center of Area A probably has a longer growing season by several days than the Armells Creek bottom.

Precipitation. Climate in the Colstrip area includes large scale fluctuations of wet and dry trends and pronounced changes in temperature. Drought conditions occur frequently, but irregularly.

The annual mean precipitation at Colstrip is 15.13 inches. Of the total, 4.9 inches or 33% of the moisture falls during April, May, and June. An additional 3.5 inches falls in July, August, and September, from scattered, intense, summer storms. The winter months are the driest period, with a mean precipitation of 2.1 inches. Most of the winter moisture is snow. The following table shows the annual average for ten years.

Table 2-1
AVERAGE PRECIPITATION
(Inches)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
.58	.60	1.00	1.64	2.26	2.94	1.23	1.22	1.19	1.22	.66	.59

Air Quality

The Federal Government and the State of Montana have established a set of ambient air quality standards (see Appendix 2, Table 1).

Colstrip air monitoring stations have shown that prior to the operation of Colstrip generating plants 1 and 2, the air was relatively

clean. The only pollution near the area is particulate matter from agricultural practices and vehicular traffic. The following table shows total suspended particulates from a high volume sampler at Lame Deer, Montana (22 highway miles from Colstrip) by the Environmental Protection Agency.

Table 2-2

PARTICULATE MATTER

1974-75

(ug/m^3 - micrograms per cubic meter)

	Sept.	Oct.	Nov.	Dec.	Jan.**	Feb.	March	April*	May	June
Mean	13.7	13.0	7.5	5.2	36	5	8.5		3.5	8.4
Max.	23.0	19.0	10.0	7.0	99	5	10.0		10.0	19.0
Min.	8.0	8.0	5.0	4.0	2	5	7.0		0	0

* No Data

** Limited Sample

The maximum State standard for particulate matter is 75 ug/m^3.

Land

Soils

Most of the following soil data is from a detailed Soil Conservation Service (SCS) survey done in July, 1974 (this advance material is subject to SCS changes).

Mapping was done on aerial photographs at a scale of four inches per mile. Soils were identified and mapped at the series level, which is the most specific level of soil identification. Seventeen soil series were identified and described in the Colstrip study area (see Appendix 2, Table 2). Two or three soil series were often mapped together as soil complexes when individual soil series were too small to be shown (see Appendix 2, Map 1 and Appendix 2, Table 3).

Soils of the Colstrip area are formed directly from parent material (geologic strata) or alluvium (stream deposits). Most are light colored due to high calcium and low organic matter contents. Some of the parent sandstone, siltstone, or shale was altered by heat from naturally burning coal beds. These altered materials are red or reddish in color. The alluvial soils occur on the flood plains, valley bottoms, and terraces in the uplands. The residual soils occur primarily on the bedrock uplands.

Most Colstrip soils are sandy loams, loams, and silt loams. Channers (flat stones) are prevalent on some ridge tops.

About 75% of the soils have a good topsoil depth and are fair or good sources of topsoil. The other soils are in the early stages of soil development and have thin rocky topsoil. Both types are suitable for reclamation.

Colstrip soils lie in a frigid temperature regime. Soil temperatures taken at a 20 inch depth show annual mean soil temperatures to be less than 47°F. The temperatures indicate that these lands are better suited for wheat production than for warm season crops such as corn.

Geology

The geology of the region surrounding Colstrip is discussed in detail by Dobbin, 1929; Miser, 1932; Pierce, 1936; and Kepferle, 1954. A stratigraphic chart listing all geologic strata down to basement rock is given in in Appendix 2, Figure 3. The Tongue River Member, which is the upper coal-rich portion of the Fort Union Formation (large and persistent unit of sedimentary rocks), and alluvium along Armells Creek are the only strata exposed within a five mile radius of Area A.

In southeastern Montana, the Tongue River Member ranges from 450 to 1,000 feet thick. It is more than 700 feet thick southwest of Colstrip (Dobbin, 1929) and about 450 feet thick at Colstrip. The stratigraphic section of the Tongue River Member (Appendix 2, Figure 4) shows the general rock types and their relative thicknesses and positions within the member. It consists of interbedded yellow sandstone, buff sandy shale, carbonaceous shale, coal, and clinker. Clinker (also called

scoria, baked shale, or porcellanite) is the reddish, erosion resistant rock that formed when burning coal beds baked the overlying sandy and shaly rocks. It is used to surface roads in the area.

Coal

Of the many coal beds in the Tongue River Member (see Appendix 2, Figure 4), only the Rosebud and McKay beds are of economic interest in the Colstrip area. Other coal seams underlie the Rosebud and McKay beds (Dobbin, 1929, Plate 7), but they are too thin and too deep to be of economic interest today. Present technology limits strip mining to coal under less than 175 feet of overburden.

In Area A, the Rosebud bed averages 24 feet in thickness and the McKay bed 8 feet. The McKay is more than 61 feet below the Rosebud bed (Matson and Blumer, 1973). Both coal beds rank as subbituminous C coal (average calorific value of 8,800 BTU's) and are quite similar chemically except for sulfur content. The sulfur content of the Rosebud bed averages about 0.7%. The McKay bed is highly irregular and averages 1.2%. Untreated or unblended McKay coal when burned does not meet Federal sulfur emission standards, which forbid burning coal containing more than 1.2% sulfur by weight. Consequently, the McKay seam is not mined by Western Energy at Colstrip, and is not discussed in this analysis.

Table 2-3
ACRES 1/ AND RESERVES OF ROSEBUD COAL IN AREA A

Area	Acres of Total Reserves	Total Reserves 3/ (Tons)	Acres of Strippable Reserves 2/ (Tons)	Total Strippable Reserves 3/ (Tons)	Total Recoverable Reserves 4/ (Tons)
Area A	3,204	136,105,920	2,670	113,421,600	104,347,870
Lease Modification Tract of 320 Acres	320	13,593,600	320	13,593,600	12,605,120

1/ The acreage figures were from planimeter measurements.

2/ This acreage equals area with only 0-150 ft of overburden except for a small portion of the 320-acre tract where the overburden reaches about 175 ft.

3/ Each acreage is multiplied by the average coal bed thickness (24 ft) to obtain the volume of coal in acre-feet. This figure was then multiplied by 1,770 tons/acre-foot, the average weight of subbituminous coal (Averitt, 1965) to yield the total tonnage.

4/ This tonnage is obtained by multiplying the "total strippable reserves" by a recovery factor of 92%.

In Area A, the "total recoverable reserves" (total amount of coal that is both technically and economically feasible to mine under present day conditions) of Rosebud coal totals nearly 105 million tons. About 12%, or 12.6 million tons, underlies the proposed lease modification tract of 320 acres.

Topography

The Colstrip area lies within the Missouri Plateau subdivision of the Northern Great Plains Physiographic Province. Near Colstrip, the topography is largely determined by the geologic strata's resistance to erosion. Area A includes isolated buttes, mesa-like hills, dissected plateaus, and long, narrow divides. Area A is essentially an upland ridge bordered on the south and east by the broad valley of the East Fork Armells Creek, and along the north by Stocker Creek (an east flowing tributary of the East Fork Armells Creek). Red, clinker-capped, dissected, upland mesas and buttes occur along the northern portion, and isolated yellow erosional sandstone remnants form bluffs in lower lying areas. This sandstone overlies the Rosebud coal bed. The topography of the proposed 320-acre lease modification tract within Area A is similar to that of the rest of Area A except that it lacks clinker-capped ridges and buttes.

In Area A, the elevation ranges from 3,230 to 3,670 feet above sea level. In the 320-acre tract it ranges from about 3,350 to 3,550 feet.

The topography of Area A is divided into seven distinct landforms. Six of the landforms are natural, and the seventh is mined land. See Appendix 2, Figure 5 for a cross-section of the following landforms:

Mesa-Butte Tops. The Mesa-Butte Top landform consists of flat-topped remnants of an older, dissected upland. They are generally capped or "held up" by clinker. Clinker is more resistant to erosion than most of the underlying rocks in Area A, therefore, it protects the softer, underlying strata from erosion. Some Mesa-Butte Tops are

underlain by resistant sandstone beds which occur between the Sawyer coal bed and the underlying Rosebud seam (see Appendix 2, Figure 4).

Mesa-Butte Steep Side Slopes. The Mesa-Butte Steep Side Slope landform consists of the steep slopes along the sides of the mesas and buttes. This slope extends from the mesa or butte edge, down to a more gentle slope. Steep slopes overlie soft and easily eroded shales, siltstones, and sandstones, often masked by clinker talus (loose debris) eroded from its overlying outcrop. South-facing slopes are usually steeper than north-facing slopes because of erosive freezing and thawing.

Massive Sandstone Bluff. The rock beneath the Massive Sandstone Bluff landform is a fine-grained, yellowish sandstone bed. The bluffs are vertical, or near vertical, and round topped. Often a more resistant, dark colored stratum underlies the upper part of these landforms. The bluffs often form winding outcrops, but they are also commonly separated from the steep slopes as sharp ridges between drainages. Sandstone bluffs are more common along the southern edge of the mesas and buttes because of the more intense erosion on southern exposures. Isolated sandstone columns rise 20 to 60 feet above the surrounding rolling countryside.

Dissected Mid Slopes. The Dissected Mid Slope landform consists of the gentle slopes between Massive Sandstone Bluff or Mesa-Butte Steep Side Slope landforms and the flood plain. Rock outcrops are sparse because soil covers much of the slope. Branching drainage patterns are characteristic on this landform.

Alluvium/Terrace. The Alluvium/Terrace landform includes the nearly level valley bottoms adjacent to the major drainages. The depth of materials deposited in such areas often exceeds 40 feet, but the width seldom exceeds a quarter of a mile. Much of the material beneath this landform was deposited by ancient streams. Most agricultural land in the region is on this landform.

Current Flood Plain. The Current Flood Plain landform includes present stream channels and their adjacent flood plains. Usually the flood plain is bordered by the Alluvium/Terrace landform.

Mined Area. The Mined Area landform consists of the portion of Area A that has already been disturbed by mining.

Land Use

The proposed lease area is being used for livestock forage, cropland, wildlife habitat, and very limited recreation.

Access to the lease area is quite good because of Armells Creek road, and several other unimproved roads. However, the lands are in private ownership and not open to those not having landowner permission. (See Table 2-4.)

Two livestock ponds and three wells within the lease area furnish water primarily to livestock, but wildlife undoubtedly use them also.

Some acreages in Sections 4, 5, and 33 have been farmed. Crops are limited mainly to dryland hay and small grains such as oats and winter wheat.

Table 2-4

AREA A SURFACE, MINERAL, AND USE OWNERSHIP

T. 2 N., R. 41 E., Montana Principal Meridian;

Legal Description	Surface Owner	Mineral Ownership
Sec. 28: SW¼	Montana Power	Western Energy
Sec. 29: S½	Western Energy	Burlington Northern "T&M" Contract 4578
Sec. 30: SE¼	Janet MacDonald	U.S. Government
Sec. 31: All	Burlington Northern	Burlington Northern "T&M" Contract 4578
Sec. 32: All	Burlington Northern	U.S. Government
Sec. 33: All (Except) (NENW, NWNE)	Burlington Northern (Montana Power)	Burlington Northern "T&M" Contract 4578

T. 1 N., R. 41 E., Montana Principal Meridian;

Legal Description	Surface Owner	Mineral Ownership
Sec. 4: All	Western Energy	U.S. Government Lease 020989-038770
Sec. 5:	Burlington Northern	Burlington Northern "T&M" Contract 3982
Sec. 6: N½	Burlington Northern	U.S. Government Lease Applied For
Sec. 6: S½	Farley's Inc.	Leased M-073109, U.S. Government

T. 2 N., R. 41 E., Montana Principal Meridian;

Legal Description	Surface Lessee	Use
Sec. 28: SW¼	Canceled	Water Supply
Sec. 29: S½	None	Evaporation Pond
Sec. 31: All	Janet MacDonald	Grazing
Sec. 32: All	*Janet MacDonald	Grazing
Sec. 33: All	Canceled	Current mining & water supply

* Sec. 32, T. 2 N., R. 41 E., Western Energy surface lease supersedes current surface lease.

T. 1 N., R. 41 E., Montana Principal Meridian;

Legal Description	Surface Lessee	Use
Sec. 4: North of Armells Creek	A Portion to Colstrip Rodeo Club Snyder	Grazing
Sec. 5: 269 acres	Hugh Broadus	Cropland
Sec. 6: N½	Farley's Inc.	Grazing

Water

Surface Water

The proposed mine area is located in the southeastern portion of the Middle Yellowstone Basin. Area A includes the divide between Stocker Creek and East Fork Armells Creek. Most of the water from Area A drains directly to the East Fork Armells Creek; the remainder drains north into Stocker Creek, which is a tributary to the East Fork Armells Creek.

Water flows through gullies to Stocker and Armells Creeks during the spring snowmelt and during intensive rainfall. During most of the rest of the year the gullies are dry, and the water in Armells Creek is in pools.

The amount of precipitation that becomes surface water or ground water depends on the total amount of precipitation, the time of year it occurs, and the intensity with which it falls. If the soil is frozen, precipitation runs off. If the soil is not frozen, but is undersaturated, the precipitation that penetrates the soil is trapped there. The rate and time of accumulation may also exceed the rate at which the soil can accept water, and additional precipitation becomes surface runoff.

Most precipitation in the Colstrip area is transpired or evaporated from plant and soil surfaces to the atmosphere or is surface runoff in small streams and coulees. The small fraction that falls when infiltration is possible, and is in excess when the soil is saturated, passes

through the soil to become ground-water recharge. Much ground-water recharge occurs through soils which are shallow and overlie permeable rock, as in the clinker areas on the ridges. Another source of recharge is from streams to the underlying aquifers (water bearing strata).

East Fork Armells Creek, Stocker Creek, and their tributaries are used primarily for livestock watering. The water is chemically acceptable for most livestock uses.

Two stock watering ponds have been constructed on the drainages in the mine area. The stream channels also have small natural pool areas which fill during periods of runoff and are used for stock watering. Some of these small natural pools may be located on the project site.

Intensive rains produce runoff that can carry sediment to the lower reaches of the drainages, where it may be deposited. No data was found that would quantify either sediment load or erosion potential.

Groundwater

Groundwater moves under the influence of gravity, through permeable subsurface materials collectively called aquifers. Three shallow aquifers are in the upper few hundred feet of strata near Colstrip--a 40-foot bed of sandstone above the Rosebud coal bed, the Rosebud coal, and the McKay coal bed. In most of Area A, however, the sandstone and the Rosebud coal do not contain water. Several productive, but deeper, aquifers (sandstone and coal beds) lie below the McKay coal bed in the Tongue River Member. The recharge (infilitration) areas for these aquifers are in the valley bottoms north of Colstrip, and in the uplands to the west.

The Rosebud seam is the major regional aquifer around Colstrip. It contains the least mineralized water in the area. Like most water in the Tongue River Member, it is slightly alkaline (pH roughly between 7.4 and 8.4). Most shallow groundwater near Colstrip contains predominantly calcium and sulfate as the cation (positive charge) and anion (negative charge), respectively (Van Voast and Hedges, 1974). Deeper groundwater (below about 125 feet) in the Tongue River Member contains predominately sodium and bicarbonate ions instead of calcium and sulfate.

Three stock wells are located within Area A:

NO 1. NENESESE, Sec. 30, T. 2 N., R. 41 E.

NO 2. NWNWNESE, Sec. 32, T. 2 N., R. 41 E.

NO 3. NWSESESE, Sec. 6, T. 1 N., R. 41 E.

LIVING COMPONENTS

Vegetation

The climax (final or mature community) vegetation of Area A has been broadly mapped and described as:

Eastern Ponderosa Pine Forest and the Grama Needlegrass - wheatgrass grassland - (Küchler, 1964)

Ponderosa Pine Savanna and *Stipa* spp. - wheat grasses grasslands - (Morris, 1964)

Ponderosa Pine Savanna and Central Grasslands - (Payne, 1973)

Mixed Prairie Grasslands and Pine Woodlands - (Westinghouse, 1973b)

These broad descriptions offer a regional overview, but do not describe all of the plant communities found within the mining area. Ecological Consulting Service (ECS) (1974d) lists plant species observed or collected in the immediate Colstrip vicinity (Appendix 2, Table 4). The vegetation on Area A has been mapped by Westinghouse (1973a and b), Sindelar (1972), and ECS (1974b and c and 1975). The BLM also has mapped the vegetation of the Colstrip area in the South Rosebud Unit Resource Analysis (URA).

The following classification system (patterned after "Ecoclass"; Corliss, et.al., 1973) was used to separate and classify the vegetative resources within the mining area on an interpretive basis:

Steppe (treeless plain) Grassland Region

Stipa comata - (Needle-and-Thread) Series

Agropyron spicatum - (Bluebunch Wheatgrass) Series

Agropyron smithii - (Western Wheatgrass) Series

Steppe Shrub Region

Artemisia - (Sagebrush) Series

Rhus - (Sumac) Series

Temperate Xerophytic (dry plant) Forest Region

Pinus - (Ponderosa Pine) Series

Mesophytic (medium-moisture plant) Forest Region

Northern Flood Plain Forest Series

Steppe Grassland Region (Often referred to as the Mixed Grass Prairie.)

This region is dominated by taller growing mid-grasses with an understory of short grasses, sedges, and forbs. Some shrub species occur on small areas where conditions are favorable (Weaver, Albertson, 1956). This mixture includes warm and cool season grasses which provide high quality forage (Appendix 2, Table 5).

Western wheatgrass, bluebunch wheatgrass, and needle-and-threadgrass, are the major grass species in the region. However, each species will show a preference for certain environmental conditions by its dominance of a community. This dominance is used to characterize the various series described in the following discussion.

Needle-and-Threadgrass Series. This series has been described by Mueggler and Handl (1974) for Montana east of the Continental Divide. Within the study area, the series favors the silty to sandy loam or clay

loam sites on the undulating midslopes and terraces. It generally occupies an edaphic (soil function) position between the bluebunch wheatgrass series and the Western wheatgrass series.

Stipa comata (Needle-and-Threadgrass) is considered an increaser, but it generally decreases with grazing in this series (Mueggler and Handl, 1974).

ECS describes a Stipa comata-Carex filifolia (Needle-and-Threadgrass and Threadleaf Sedge) grassland community on Western Energy's Mining Area A (ECS, 1974c and 1975). Their studies indicate the range condition in this plant community ranged from "good" to "fair" on transects conducted in 1974 and 1975 respectively. Total plant annual foliage production in this community was estimated at 845 pounds per acre (ECS, 1975).

Bluebunch Wheatgrass Series. This series also has been described by Mueggler and Handl (1974) for Montana east of the Continental Divide. Within the mining area, this series favors the dry, rocky, shallow soils of the steeper slopes and toe slopes.

ECS (1974c and 1975) describes several plant communities with a common occurrence of bluebunch wheatgrass in Area A. Range condition for this area was rated as "poor" to "excellent" in these community types during their studies. Total plant annual foliage production for these types ranged from 283 to 1,235 pounds per acre in 1975 (ECS, 1975).

Western Wheatgrass Series. The U.S. Department of Agriculture publication, Ecoclass, A Method for Classifying Ecosystems, lists this

series as a possibility in the Steppe Grassland Region. Anderson (1973) describes a Western wheatgrass type for eastern Montana.

This series is found on the clay to clay loam soils, usually on the lower end of the midslopes, especially on alluvial clay flats and along the flat bottoms of small drainages as well as on the level portions of the open valleys.

Due to the wide distribution and diversity of grazing pressures on this vegetation series, foliage production estimates vary considerably (ECS, 1974c and 1975; Sindelar, 1972).

Other Grassland Communities. Several small grassland communities occupying micro-environments are found throughout the Steppe Grassland Region. They are too small to map, but they are distinctive and worthy of note:

Andropogon scoparius (Little bluestem) - *Calamovilfa longifolia* (Prairie sand reedgrass) Community. These communities occur as small dense patches on dry, sandy slopes or hillsides.

Bouteloua curtipendula (Side oats grama) Community. These communities occur on the tops and slopes of dry rocky ridges.

Stipa viridula (Green needle grass) Community. Although green needle grass is found throughout the Mixed Grass Prairie as an associated species, it will occur as the dominant grass in small communities located on vertisol soils (Morris, 1964).

Steppe Shrub Region

This vegetative region is typically found on the steep slopes of the rough, broken, "bad lands" topography; in the more open or gentler topography as a transition between the Ponderosa Pine Series and grasslands; in moist micro-environments such as small draws and swales; and along the slopes of minor ridges. This region's flora is similar to one or more of the grassland series, except for the dominance of shrubs. Physiographic and edaphic conditions, insofar as they may influence the availability of soil water, appear to be the principal factors controlling the distribution of this shrub region.

Sagebrush Series. Brown (1971) has described several communities within this series that are found in the mining area. The *Atriplex* (Saltbush)-Sagebrush community is moderately tolerant of saline soils and is restricted to steep slopes of exposed rock. The vegetation of this community is mainly concentrated along contouring micro-benches resulting from erosion. The Sagebrush-Saltbush-Wheatgrass community is restricted to moderate slopes with a shallow layer of sandstone talus, and the closely related Sagebrush-Wheatgrass community is found on more gentle slopes with deeper talus accumulations.

Although sagebrush species occurred throughout much of the mining area prior to the grazing of domestic livestock, its presence was more characteristic than one of dominance. The present widespread dominance of sagebrush on many sites may be due to the fact that it is an increaser in communities that have been depleted by overgrazing. Plains

pricklypear (Opuntia polycantha), annual weeds and grasses, and decreases in perennial grasses are also indicative of current overgrazing.

ECS (1974c and 1975) and Sindelar (1972) list annual foliage production estimates for community and range types, respectively, including sagebrush series in the immediate Colstrip vicinity.

Sumac Series. Brown (1971) described a Sumac-Wheatgrass community which he found on outcrops of porcellanite material (clinker) on moderate to steep slopes, usually near ridge tops. Mueggler and Handl (1974) also describe a Rhus trilobata (skunkbush sumac)/Bluebunch wheatgrass habitat type. This series also occurs within Area A as a transition zone between the Ponderosa Pine Series and the Steppe Grassland Region, on soils that tend to be sandy clay loam in texture, undefinable to extremely thin in profile, and underlain by scoria or shale.

If undisturbed, bluebunch wheatgrass would be the dominant grass species in this series. Other associated species may include western wheatgrass, blue grama (Bouteloua gracilis), June grass (Koeleria cristata), green needlegrass, needle-and-threadgrass, rubber rabbitbrush (Chrysothamnus nauseosus), prairie rose (Rosa arkansana), juniper (Juniperus spp.), squaw current (Ribes cereum), snowberry (Symphoricarpos spp.), and chokecherry (Prunus virginiana).

Temperate Xerophytic Forest Region

This region is characterized by a forest of scattered to dense stands of relatively slow growing, drought tolerant trees. In the

Colstrip area, this vegetation region is dominated by ponderosa pine (Pinus ponderosa) and Rocky Mountain juniper (Juniperus scopulorum) with a comparatively sparse understory of midgrasses, forbs, and shrubs. Since the Colstrip vicinity lies along the dry (10"-14" annual precipitation zone) edge of the gradient between the steppe shrub and temperate xerophytic forest region, dramatic manifestations of climatic factors are apparent. Along the north and east slopes of mesas, and alongside the upper reaches of drainage channels in coarse soils, the forest is prevalent. In denser soils on level terrain with no moisture, temperature, or edaphic advantage, the shrub and grass vegetation aspect predominates. Thus, the overall aspect of the temperate xerophytic forest region, in this area, is represented by a coniferous savannah or scattered foothills woodland.

Ponderosa Pine Series. Although ponderosa pine is used to distinguish this series, the understory vegetation will vary with a change in physiographic and edaphic conditions.

Where this series occurs on dry, low elevations, the understory is usually dominated by bluebunch wheatgrass. At higher elevations, or in areas of relatively higher moisture accumulation, bluebunch wheatgrass is replaced by Idaho fescue (Festuca idahoensis). These communities correspond closely with the Ponderosa pine/Agropyron spicatum habitat type and the Ponderosa pine/Festuca idahoensis habitat type described by Pfister, et. al. (1974).

On some moist sites the understory is dominated by shrubs such as snowberry, skunkbush, rose, and (in certain locales) Rocky Mountain

juniper. These communities are similar to the Ponderosa pine/ Symphoricarpos albus habitat type described by Pfister et.al., (1974), and the Pinus-Juniperus community described by Brown (1971).

The ponderosa pine series is common on the rocky or coarse soils associated with steep slopes and broken topography. Although an occasional tree may reach commercial size, the individual trees are too scattered to be classified as a commercial forest area.

Occurrence of plains pricklypear, fringed sagewort (Artemisia frigida), big sagebrush (Artemisia tridentata), broom snakeweed (Gutierrezia sarothrae), annual grasses and forbs, and high lining of the juniper trees are all indicators of overgrazing in this series.

ECS (1975) examined a Pinus ponderosa/Agropyron spicatum community type in the mining area and found the range condition to be excellent. Total annual foliage production estimates of 507 pounds/acre were recorded on this type.

Mesophytic Forest Region

This vegetation region is a riparian (river-bottom) extension of the eastern deciduous forests. It is confined to floodplains and is poorly exhibited in the Western Energy mining areas.

Northern Flood Plain Forest Series (Küchler, 1964). This series is typically found as a narrow band on level to slightly sloping topography of the current flood plains, on soils that range from silty loam to sandy loam.

The overstory vegetation includes such hardwood species as box-elder (Acer negundo), green ash (Fraxinus pennsylvanicus), and plains cottonwood (Populus deltoides). Shrub species include silver sage (Artemisia cana), snowberry (Symphoricarpos spp), skunkbush sumac (Rhus trilobata), and rose (Rosa spp).

ECS (1975) defined an Acer negundo/Fraxinus pennsylvanica/Poa spp/Agropyron smithii community type in the Colstrip mining areas. However, no range conditions or foliage production estimates were recorded for this type during their studies.

Aquatic Vegetation

Only two stock water reservoirs and one intermittent stream (East Fork Armells Creek) have been identified in mining Area A. No site specific aquatic information currently exists for these areas.

Endangered or Threatened Plant Species - Relict Areas

The Soil Conservation Service describes sites of climax vegetation that have not been disturbed by man, either through grazing or any other means, as "relict areas." It is doubtful that any "relict areas" are present within the Western Energy Mining Area A.

The U.S. Fish and Wildlife Service currently is considering 10 Montana plants as candidates for inclusion on the endangered or threatened flora list of the U.S. No specific data presently available indicate the location or existence of endangered or threatened plant species candidates in this area.

Animals

Mining Area A is within Montana Fish and Game hunting District number 722. District 722 is an area of about 1,340 square miles situated between Interstate 94 and the Northern Cheyenne Indian Reservation. It is bounded on the east by Rosebud Creek, and on the west by Sarpy Creek. Mining Area A comprises less than 1% of hunting District 722.

Mule Deer

The mule deer is the principal big game animal in Montana and District 722. Within the mining area they are widespread in distribution.

There are no extensive seasonal movements, but local movements are made in response to weather conditions and forage preferences.

Primary deer habitat includes all existing vegetative types except the extensive grasslands and agricultural lands (ECS, 1973b). Ecological Consulting Service (1973b and 1974e) observed the importance of the Ponderosa Pine Series to mule deer in the mining area. The many plant communities within this zone provide the bulk of the mule deer's habitat needs. The Ponderosa Pine Series is interspersed with open vegetative types which create considerable vegetative diversity and "edge effect." Preference of deer for ecotonal areas (edges) and areas near denser vegetative cover (Appendix 2, Table 6) are documented by Dasmann (1971), Richens (1967), and Skovlin et al., (1968). Deer also commonly utilize topographic relief as cover. The Northern Great Plains Resource Program

(1974) gave mule deer habitat quality in the Colstrip area the highest rating in a regional study of eastern Montana, northeastern Wyoming, western North Dakota, and western South Dakota. The Colstrip area was a "stronghold" of mule deer even during the 1940's when mule deer distribution was much more restricted than presently shown by Mussehl and Howell (1971).

Many of the sagebrush communities occur on middle slopes and alluvial fans between the ponderosa pine and grassland zones. Big sage habitat type and forage become important in winter and spring. ECS (1973b) observed the importance of the silver sage-grassland habitat type to deer in March. Rubber rabbitbrush, a major winter browse species, was found primarily on steep, eroded slopes of mesas and buttes referred to as the Caprock Gumbo Knob by ECS (1973b). These sites support a big sage-rabbitbrush-saltbrush (*Atriplex confertifolia*, *A. nuttallii*) community which receives apparent heavy winter deer use.

During most years, shrubs are the major forage class utilized by deer. During spring, early green-up species of grasses and forbs become quite important. As green forage becomes more readily available, forbs are selected throughout the summer, and are supplemented with deciduous shrubs. During the fall deer begin a transition from forbs and summer (deciduous) browse, to winter (evergreen) browse. Green grass regrowth is also selected, to a minor extent, at this time. During the winter, evergreen shrubs predominate the diet (Appendix 2, Figure 6).

Browse transects conducted by the Montana Fish and Game Department (1972) in Region 7 indicated good browse conditions except for rubber

rabbitbrush. Rabbitbrush was excessively utilized and in severely hedged condition. Transects established in and near the mining area by ECS (1973b) indicated light use of key browse plants except rubber rabbitbrush. Rubber rabbitbrush is the least abundant of the key shrubs utilized during winter (big sage, silver sage, rubber rabbitbrush, and juniper). Rabbitbrush in this area shows signs of excessive past deer use on most sites where it occurs. Its recovery may play a role in the fluctuation of the deer herd. Montana Fish and Game data (1972) indicates browse in the management unit was in poor condition from 1965 to 1968. Recent data indicates good to excellent ratings. Indications are that the deer herd in Area 722 is productive and healthy during favorable years. Eustace (1971) reported a fawn/doe ratio of 87/100 in 1970. ECS (1973b) found a fawn/doe ratio of 58/100 near the mining area in 1973. By Montana Fish and Game criteria, the 1971 production is rated as good and the 1973 production as poor. ECS (1973b) speculated that below normal spring precipitation in 1972 may have influenced the low 1973 production.

White-Tailed Deer

White-tailed deer are of minor importance on the mining area in terms of relative abundance or harvest. However, they have high aesthetic value and are commonly observed in the Colstrip area. White-tailed deer habitat in Area A is primarily limited to riparian growth along Armells Creek. There is very little prime habitat present

and few observations are reported (ECS, 1973 b). Whitetail have extended their distribution since the 1940's, but habitat along Armells Creek is limited. Agricultural practices tend to keep the natural encroachment of broadleaf trees and shrubs in check along the fertile drainage bottoms.

Antelope

Antelope occur in Mining Area A in extensive open habitats. Antelope also utilize openings in sparsely timbered areas, but not generally in heavily timbered areas. Primary antelope habitat consists of open, brushy steppe grasslands and steppe shrub regions along the East Fork Armells Creek. More extensive antelope habitat occurs immediately north and west of Area A. ECS (1973b) identified five antelope winter utilization areas near Colstrip which should be considered as crucial habitat. None of these winter utilization areas occurred on Area A. Antelope can be seen regularly during the summer along the Armells Creek drainage, including Area A. The entire Colstrip vicinity is "less-than-optimum" antelope habitat. The Northern Great Plains Resource Program (1974) rated antelope habitat quality as medium and low in the Colstrip area. Montana Fish and Game studies suggested antelope population density was much lower in this hunting district than the average for southeastern Montana in 1970 and 1972 (Wentland, 1973).

Antelope near Colstrip use the skunkbush-grassland community heavily throughout the year (ECS, 1973b). The silver sagebrush community was very important in March and April (ECS, 1973b). Antelope

typically search for succulent forbs on croplands during late summer and fall as the range forbs become dried out.

Antelope diet is typically about 90% forbs during the summer and about 90% browse during the winter. During the spring, antelope utilize early growth of grasses for a short period and during the fall, browse progressively becomes predominant in the diet. One or more sagebrush species are invariably critical to antelope survival in Montana. ECS (1974a) analyzed eight rumens from hunter-killed antelope near Colstrip. Browse was most important in the fall diet, totaling 85% of the total. Silver sagebrush and snowberry constituted 40% and 28% of the diet, respectively. Grass and forb use totaled only 4% and 11%, respectively. Four species of Artemisia were found in the diet, attending to the major role of this genus.

Antelope are strongly dependent upon sagebrush (silver or big) during winter. ECS (1974a) commented upon the importance of swales and coulees during fall, since these sites support luxuriant stands of sage and snowberry.

The primary antelope limiting factor throughout the Northern Great Plains is believed to be the increasing lack of high quality sage-grassland habitat.

ECS reported an average antelope fawn/doe ratio of 36/100 for the months of September through November, 1973, around Colstrip. Montana Fish and Game data (Wentland, 1973) showed production (fawn/doe ratios) in 1969 and 1972 was 86/100 and 65/100, respectively. Recognizing that

production varies annually with climatic conditions and other factors, these data suggest a relatively low productivity of Colstrip antelope.

Sharp-Tailed Grouse

Sharp-tailed grouse occur throughout Mining Area A and are the most important local game bird. Sharptails inhabit brushy grasslands where shrubs seem to be an essential habitat component. ECS (1973b) found that Rhus-grassland and silver sagebrush-grassland habitats were preferred. Edminster (1954) found that brush should cover 5% to 50% of the ground to provide optimum habitat. Key shrubs for sharptail use are skunkbush, silver sagebrush, big sagebrush, rose, chokecherry, and snowberry.

During the spring breeding season males congregate on traditional grounds, where they defend small breeding territories. A social hierarchy develops, in which the dominant cocks do most of the breeding. The dancing ground is thus the focal point of a breeding complex, thus is considered as crucial habitat. ECS (1973b) identified heavy utilization areas for sharptails near Colstrip. One known sharptail lek (dancing ground) occurs within one mile of Area A.

Adult sharptails are primarily vegetarians, but Pepper (1972) found insects comprised the bulk of the chicks' diet for up to 10 weeks. Summer foods typically include a large amount of leaves and flowers of succulent plants, dry seeds, and fruits (Edminster, 1954). ECS (1973b) analyzed 11 sharptail crops collected near Colstrip during October and November. Rose hips and Rhus berries comprised 78.9% of the forage use,

and dandelion leaves and flowers 14.3%. Snowberries were also present in sharptail crops. Eustace (1968) found the September diet was composed of grasshoppers, wheat (22%), and rose hips (15%). Six crops analyzed in October showed a decline in grasshoppers and an increase in wheat and rose hips. Edminster (1954) reports the winter diet as buds, twigs, and catkins. During spring, greens are selected.

A sharptail limiting factor in this area may be a lack of residual herbaceous vegetation for escape and nesting. Harvest of crops also contributes to mortality, since sharptails will nest in croplands near woody cover.

Rosebud County is one of the top four sharptail producing counties in southeastern Montana. Sharptail harvest in Rosebud County for the years 1968 to 1971 was 10,506 (Wentland, 1972; Martin, 1971).

Ring-Necked Pheasant

Rosebud County is a major pheasant producer in southeastern Montana. Pheasant harvest in Rosebud County for the years 1968 to 1971 was 10,093 birds, which was similar to sharptail harvests (Wentland, 1972; Martin, 1971). Ring-necked pheasant on Area A are restricted to the Armells Creek drainage where cropland adjoins riparian growth or weedy and wasteland areas. Cultivated crops provide the bulk of pheasant foods. Pheasants also prefer seeds of weedy plants associated with disturbed land and agriculture for forage. Crowing counts conducted by ECS and the Montana Fish and Game Department indicate

the Armells Creek population is much lower than that of nearby Rosebud Creek. The average crowing count on Rosebud Creek was 14.4 crowing calls/station, as opposed to 2.5 crowing calls/station on Armells Creek.

Hungarian Partridge, Sage Grouse, and Waterfowl

These are minor game birds on the mining area in terms of relative abundance or harvest. However, they have high aesthetic values and are commonly observed in the Colstrip area.

Hungarian partridge were observed only at six sites by ECS (1973b, 1974e) during a full two years of study at Colstrip. Croplands (preferably grain and corn) and native grassland or hayland are two cover requirements (Edminster, 1954). Some grain croplands and hayfields exist on Area A. Rosebud County partridge harvest in 1970 and 1971 was only about 10 to 15 percent of the pheasant or sharptail harvest.

Prime sage grouse habitat appears to be lacking on Area A. No strutting grounds are known to occur there. The nearest known strutting grounds occur about eight miles east and seven miles north of Area A. ECS (1973b, 1974e) observed only 69 birds in the Colstrip area.

Waterfowl may occasionally be seen on Armells Creek, which they may use as nesting and feeding habitat. Area A lacks breeding or brooding habitat, but some breeding occurs on lower Armells Creek outside the mining area.

Mourning Doves

Mourning doves are a major wildlife resource on the area, but they are a non-game species in Montana; little factual data on their status

are available. Doves breeding in Montana winter in states to the south where many are harvested as game birds. Doves appear quite numerous in the area.

Non-Game Birds

Information on breeding birds in the Colstrip vicinity was acquired through field observations, documented by Westinghouse (1973), ECS (1974e), and U.S. Fish and Wildlife Service sponsored breeding bird surveys conducted by W. P. Roney (1968-72) and J. H. Phelps and W. P. Roney (1973-74). No thorough ecological studies of the non-game bird life of this region have been completed.

Shrub-grassland birds were predominant, with 24 common and 18 uncommon species (Appendix 2, Table 7). Of the 42 species represented, 34 are deemed prairie shrub habitat species only and are poorly represented in other habitats. An observer in the prairie shrub habitat will readily see meadowlark, red-winged blackbird, Brewer's blackbird, lark bunting, lark sparrow, Brewer's sparrow, western kingbird, eastern kingbird, mourning dove, sharptail grouse, kestrel, red-tailed hawk, and ring-necked pheasant.

Ponderosa woodland birds are well represented, with 19 common and 17 uncommon species (Appendix 2, Table 7). About one-third of these species are found in either riparian or prairie shrub habitats as well. An observer in the woodlands will readily see flicker, red-headed woodpecker, pinyon jay, lark sparrow, lazuli bunting, rufous-sided towhee, Bullock's oriole, western wood peewee, brown thrasher, and house wren.

Riparian birds are well represented, with 18 common and 12 uncommon species. About half of these species are found in woodland or prairie shrub habitats also. The riparian habitat seems to be exclusive for only yellow warbler, common yellowthroat, yellow-breasted chat, tree swallow, and American goldfinch. Riparian species are present in large numbers, suggesting this is a very diverse and productive bird habitat.

Ten species were found in a variety of habitats (ubiquitous). Common species include house sparrow, rock wren (where caprock occurs), robin, black-billed magpie, common crow, common raven, common nighthawk, and cliff swallow. Uncommon species included the great-horned owl and golden eagle.

A total of 85 breeding bird species have been identified in the Colstrip area. These species make significant use of habitats on Mining Area A. Many more migrant and uncommon species could be added to this list, but it's unlikely that their survival and productivity is dependent upon habitats in the mining area.

Although no population density data are available, the area supports a large population of passerine birds. Breeding bird data (Appendix 2, Table 8) collected by Phelps and Roney (1973-74) and Roney (1968-72) show no decline in number of breeding species from 1968 to 1974. However, data on bird numbers are not statistically valid.

Reptiles and Amphibians

Reptiles and amphibians recorded by Westinghouse (1973a and b) for the Colstrip area are listed in Appendix 2, Table 9. Amphibians would

be associated primarily with the moist riparian habitat in Armells Creek. No site specific population data is available for reptiles and amphibians in this area.

Non-Game Mammals

Non-game mammal species verified on Area A through observation or trap set are indicated in Appendix 2, Table 10. Unverified species also may occur on the area because suitable habitat exists, and normal distribution includes the Colstrip area (Hoffman and Pattie, 1968). Mammals of Colstrip appear to be typical of short grass prairie habitat. However, woodland species, like the red squirrel (Tamiasciurus hudsonicus) are poorly represented.

Information on small mammals are derived principally from Westinghouse (1973), ECS (1973a and b and 1974c and e), and limited field observation by BLM personnel. Of the 37 mammal species thought to inhabit the area, 28 species are verified through observation or trapping. Non-game mammal population status is largely undetermined.

Mammal habitat has been drastically altered from the original mid grass grassland by stock grazing and agricultural practices. The black-tailed prairie dog (Cynomys ludovicianus) was formerly much more abundant, but has been reduced to small isolated colonies through poisioning (Hoffman and Pattie, 1968). ECS (1973b) located a prairie dog town near Stocker Creek, outside Area A. No prairie dog towns are known to occur within Area A.

Trapping by ECS (1973a and b, and 1974c) indicated the most common small mammal is the western deer mouse (Peromyscus maniculatus). Other small mammals trapped were white-footed mice (Peromyscus leucopus), prairie vole (Microtus ochrogaster), common shrew (Sorex cinereus), least chipmunk (Eutamias minimus), and thirteen-lined ground squirrel (Spermophilus tridecemlineatus). Data from traplines by ECS (1973a and b, 1974c) are presented in Appendix 2, Table 11. No conclusions were derived for species habitat use, except for the western deer mouse which was most numerous in the skunkbush-grassland and the saltbush-sagebrush sites.

The mammal predator population of the Colstrip area includes raccoon (Procyon lotor), red fox (Vulpes vulpes), bobcat (Lynx rufus), coyote (Canis latrans), badger (Taxidea taxus), striped skunk (Mephitis mephitis), and long-tailed weasel (Mustela frenata). The wolf (Canis lupus), swift fox (Vulpes velox), and grizzly bear (Ursus arctos) occurred in the area during earlier times but have since been exterminated. The small predators listed are fairly common.

Raptors

Common raptors at Colstrip include the kestrel (Falco sparverius), red-tailed hawk (Buteo borealis), and marsh hawk (Circus cyaneus). The kestrel is by far the most abundant. All three of these raptors nest in the Colstrip area.

Swainson's hawks (Buteo swainsoni), ferruginous hawks (Buteo regalis), golden eagles (Aguila chrysaetos), and prairie falcons (Falco

mexicanus) are expected to occur in the Colstrip area. Bald eagles (Haliaeetus leucocephalus) winter in substantial numbers along the Yellowstone River, thus occasional winter observations in the Colstrip vicinity might be expected.

Winter golden eagle surveys of western states by the Bureau of Sport Fisheries and Wildlife (1973-74) indicate the largest populations are present in northwestern Colorado, Montana, Utah, and Wyoming. The Montana survey area, between the Yellowstone and Missouri Rivers, is about 30 miles north of Colstrip. The 1973 and 1974 surveys averaged one golden eagle per 9 square miles, and one per 8 square miles, respectively. The western states average one golden eagle per 11.5 square miles. It is difficult to apply large area averages to small, specific sites with a degree of certainty; however, there is no reason to believe that similar eagle winter use does not occur in the Colstrip area.

Endangered or Threatened Fauna

Endangered wildlife species are those listed by the U.S. Government in the Federal Register (U.S.D.I. - FWS, 1973). Endangered species are not known to occur as residents within the mining area, but some may occasionally be seen as migrants.

Black-footed ferrets are associated primarily with prairie dogs (Snow, 1972). The only known prairie dog town in the vicinity of Colstrip occurs outside of Mining Area A. ECS (1973b and 1974e) conducted

several inspections of the known prairie dog town and observed no ferret sign.

No recent observations of peregrine falcons are known for Area A.

The prairie falcon, mountain plover, and ferruginous hawk are listed by the U.S. Fish and Wildlife Service (1973) as possible candidates for the official endangered species list. No known critical habitat of these species occurs in Area A.

Aquatic Wildlife

Very little aquatic habitat exists on Area A, thus most wetland wildlife is absent. Muskrats, raccoons, and several species of waterfowl are found along Armells Creek (ECS, 1973a and b, 1974e). Most typical wetland species would be considered "accidentals" or "transients" if observed on Area A.

ECOLOGICAL PROCESSES

Ecoclass

Since landforms are an important part of the environment, broad natural relationships can be revealed by relating landforms and associated features as Ecological Land Units (ELU's). ELU's are geographic areas which are separated and named according to landform and vegetation (Corliss, et al., 1973). Each ELU has individual elements (landform, vegetation, soils, water, wildlife and human values) which make it different from other ELU's. Furthermore, each ELU has its particular degree of interdependence of the natural elements within the ELU. This relationship is shown in Appendix 2, Figure 7.

The cross section in Appendix 2, Figure 5 illustrates typical landforms and associated vegetation which make up the ELU's found in the Colstrip vicinity. The landforms are (1) Mesa-Butte tops, (2) Mesa-Butte steep side slopes, (3) Massive sandstone bluffs, (4) Dissected mid slopes, (5) Alluvium/terraces, (6) Current flood plain, and (7) Mined area.

These seven landforms can be subdivided into twelve natural and three artificial ELU's (13 of which occur on Area A). These also show relationship between landform and vegetative type:

Table 2-5

ECOLOGICAL LAND UNIT
(ELU) NAMES

1.	a.	Mesa-Butte top - Steppe Grassland (MBT-SG)
	b.	Mesa-Butte top - Steppe Shrub (MBT-SS)
	c.	Mesa-Butte top - Xerophytic Forest (MBT-XF)
2.	b.	Mesa-Butte Steep side slopes - Steppe Shrub (MBSS-SS)
	c.	Mesa-Butte Steep side slopes - Xerophytic Forest (MBSS-XF)
3.		Massive Sandstone Bluff (MSB)
4.	a.	Dissected Mid Slopes - Steppe Grassland (DMS-SG)
	b.	Dissected Mid Slopes - Steppe Shrub (DMS-SS)
	c.	Dissected Mid Slopes - Xerophytic Forest (DMS-XF)
	e.	Dissected Mid Slopes - Cropland (DMS-C)
5.	a.	Alluvium/Terrace - Steppe Grassland (A/T-SG)
	b.	Alluvium/Terrace - Steppe Shrub (A/T-SS)
	e.	Alluvium/Terrace - Cropland (A/T-C)
6.	d.	Current Flood Plain - Mesophytic Forest (CFP-MF)
7.		Mined Area

The acreage for mining Area A ELU's are shown below:

Table 2-6

ACREAGE AND PERCENTAGE ESTIMATES
(ELU's on Western Energy Mining Area A and
E½ Section 32, T. 2 N., R. 41 E., Colstrip, Montana)

ELU 1/	Entire Area "A" Acres 2/	Entire Area "A" %	E½, Section 32 Acres	E½, Section 32 % 3/
MBT-SS(1b)	38	1.0		
MBSS-SS(2b)	134	3.5	2	0.5
MBSS-XF(2c)	247	6.5	12	3.8
MSB(3)	53	1.4	8	2.4
DMS-SG(4a)	559	14.6	61	19.1
DMS-SS(4b)	1,100	28.9	142	44.5
DMS-XF(4c)	457	12.0	95	29.7
DMS-C(4e)	414	10.9		
A/T-SG(5a)	39	1.0		
A/T-SS(5b)	61	1.6		
A/T-C(5e)	295	7.7		
CFP-MF(6d)	55	1.5		
Mined Area(7)	140	3.7		
Townsite	96	2.5		
Facilities Site	161	4.2		
TOTAL AREA	3,814 (5.96 Sections)	100%	320 (½ Section)	100%

1/ The townsite and facilities site, although not technically ELU's, comprised part of the acreage inside the boundary of W. E. Mining Area "A."

2/ Acreage estimates were made with the aid of a dot-grid acetate overlay (Scale = 462 dots/640 acre section).

3/ The E½, Section 32, comprised approximately 8.4% of Western Energy Mining Area "A."

Appendix 2, Figure 8 shows ELU's in mining Area A (1974 color infra-red photo base). ELU boundaries may imply definite breaks in

relationships, however, some boundaries between ELU's are diffused, and some ELU's contain portions of other ELU's too small to be mapped individually (see Appendix 2, Photo 1, pages 1 through 10 for pictures of the ELU's in Area A).

Unique Ecosystems (Environmentally Sensitive Areas)

A unique community is sometimes defined as " . . . one which is extremely limited in extent or occurrence and/or possesses attributes of special academic interest." Using this definition, the E½ of Section 32 (proposed modification) does not appear to be "unique." Both the floral and faunal communities found here are common throughout the physiographic region and do not possess any particular academic significance.

Environmentally sensitive areas have been defined as " . . . ecologically fragile and consequently extremely vulnerable to destruction . . ." (Smithsonian, 1974). Marginal conifer tree growth and vulnerable massive sandstone bluffs occur in this area but their ecological function can be mitigated (see Chapter 4).

Succession - Climax - Limiting Factors

Approximately 30% of mining Area A surface lands are disturbed by agricultural cultivation, strip mining and related facilities, and human residential sites; therefore, the natural succession (orderly process of community change) has been altered. The remaining area is largely rangeland, well grazed by domestic livestock. As a result, this rangeland exists in varying degrees of disclimax. Since the entire range area is accessible to domestic livestock, no vegetative "relict" areas exist in Area A. At present in this biome (the largest land community unit which is convenient to recognize), the principal environmental

limiting factor for vegetative growth is the availability of moisture for plant growth. Many man-caused land use practices also limit native vegetation and wildlife.

Community - Food Relationships

Area A is over 70% native rangeland, with a relatively high natural diversity (see Appendix 2, Figure 9). At present, wildlife habitat is not severely limited or encroached upon. Most ecological "niches" are filled with native species. Some of the "niches," however, are filled or replaced by agricultural plantings and species introductions. Plant communities are well mixed. The natural food chain relationships remain well represented at all trophic (food) levels, with the possible exception of large herbivores (plant eating animals) and large carnivores (meat eating animals). Large carnivores remain scarce, and large native herbivores have been replaced by domestic livestock in most cases. Natural nutrient cycles may have been altered through fertilization of croplands for agricultural production.

Aesthetics

Aesthetics, as used in this analysis, concerns the overall appearance of the landscape as perceived through the senses of sight, sound, smell, taste, and touch. Since 87% of man's perception is based on sight, major emphasis will be placed on the visual resources. Taste and touch are too insignificant to warrant consideration. A description of the procedure used for visual resource interpretation and the scenic quality inventory chart are contained in Appendix 2, Figure 10a.

Visual Resources

Visual Quality. Mining Area A and the immediate vicinity was divided into 3 rating areas (see Appendix 2, Figure 10). The criteria for establishing these areas were primarily landform and degree of man-caused disturbances. The total score for a given area can range from 1 to 24 (see Chart in Appendix 2, Figure 10a). After the numerical rating is determined, the area is assigned a letter based on the following range of scores: A (High Quality) 15-24; B (Moderate Quality) 10-14; C (Low or Average Quality) 1-9.

In Appendix 2, Figure 10, "Class C-2" includes the town of Colstrip, areas already disturbed by mining, and intermingled areas which are predominately farmlands. (See Chart in Appendix 2, Figure 10a.) The area received minimum ratings for all factors except uniqueness, which

was rated moderate. The low rating is based on the fact that the town and the mining detract from the overall natural appearance of the region.

"Class C-6" contains the relatively level portion of the valley formed by East Fork Armells Creek. The intrusion factor was rated moderate as a result of numerous roads, fences, and some farmland. All other factors received minimum ratings.

"Class B-10" contains the partially-timbered uplands on the ridge north of East Fork Armells Creek. This area received a maximum rating for the intrusion factor; moderate ratings for landform, color, and vegetation; and a minumum rating for water. Most of Area A and all of the proposed lease modification are included in this rating area.

Landscape Character Elements. Basic character elements (form, line, color, texture) in relation to Colstrip can be described as follows:

Form. Area A has weak to moderate form with the ridge north of Armells Creek being most pronounced. The small tributary drainages enhance the massive appearance of the land form by exaggerating the vertical relief. The valley bottom is essentially formless except for the artificial geometrical appearance of farm fields. The proposed lease modification area does not contain any farmland.

Line. The line element is generally weak within the area. It is exhibited, in a general way, by the parallel alignment of the creek bottom and adjacent ridge. This is accentuated by the changes in

vegetation and color resulting from changes in elevation, soil, and rock outcrops. The most pronounced example of this element is the abrupt contrast at the edges of the farm fields.

Color. The color element is generally weak to moderate in the area. Its relative dominance will vary seasonally but generally serves to enhance the line and texture elements. The scattered ponderosa pine and the sandstone and scoria outcrops provide constant colors which contrast with each other and seasonal changes in the other vegetation.

Texture. Texture is considered the most dominant of the four elements in the area but can only be considered as moderate in strength. It results from the combination of vegetative patterns, rock outcrops, and dendritic (branching) drainage patterns which combine to create a moderately rough appearance over most of the area.

In summary the area can be characterized as an open or panoramic landscape. Texture is considered to be the dominant element by a slight margin. This is closely followed by color and form in nearly equal proportions. Cattle ranching activities tend to enhance the open, "old west" characteristic. The mining and power plant activities adjacent to Colstrip, and to a lesser degree the farming operations, are not harmonious with this overall character. Due to the length of time that mining and farming have been carried out they could be considered separate landscapes. The sharp contrast at the boundaries of the landscapes accentuates the differences in character.

Sound and Smell

The mining operations, powerplant construction activities, railroad, and vehicle use in and adjacent to Colstrip produce noise and odors which are not consistent with the "old west" nature of the general vicinity. The noise and odor have, to a relative degree, occurred since the beginning of mining in 1928. Therefore, they have become a part of the local area aesthetic setting. They are not unduly offensive to the average citizen of the area and do not create any health problems.

Recreation

Area A

Area A has no developed recreation facilities. There is no data available regarding existing use in the area, but some hunting and other dispersed forms of recreation probably occur. The primary opportunities are for hunting, sightseeing, camping, and picnicking in undeveloped sites. The opportunities for general public use are limited because the land is all privately owned.

General Area

The proposed lease modification area lies within Planning Region 3 (see Appendix 2, Map 2), as established by the Montana Statewide Outdoor Recreation Plan (SORP). The following discussion draws heavily from SORP data; however, it should be noted that statistics for Region 3 are based on a very low number of responses and cannot be considered definitive. Also, the surveys were conducted in 1971-72 and may not indicate use patterns or preferences of new residents in the region.

Recreation Use Characteristics. Indoor spectator activities are the most popular use of leisure time by Region 3 residents. Outdoor recreation is second in popularity and is closely followed by home-related activities.

Table 2-7 compares the ten most popular activities engaged in with stated preferences. This indicates some substitution of available

activities for preferred activities that are unavailable, or that unmet demands for some activities exist.

Table 2-7

PLANNING REGION 3

Comparison of outdoor recreation activities engaged in and stated activity preferences (yearly totals) -- weighted percentages.

Engaged In	%	Stated Preference	%
Driving for pleasure	18.4	Driving for pleasure	11.5
Walking for pleasure	10.0	Walking for pleasure	9.3
Sightseeing	9.2	Hunting	9.1
Fishing	6.6	Fishing	8.4
Playing outdoor games	6.1	Sightseeing	8.0
Back country touring 4WD	5.7	Motor bike riding	5.8
Hunting	5.1	Snowmobile riding	4.9
Picnicking	4.8	Playing outdoor games	4.6
Motor bike riding	4.7	Motor boating	4.3
Bicycling	4.1	Horseback riding	4.3

Region 3 residents prefer undeveloped natural environment areas by a slight margin over general outdoor recreation areas. Recreation area type preferences are illustrated in Appendix 2, Figure 10b. The local forested areas are popular. Sites are chosen because they are close and/or a specific activity is available. Montana residents accounted for 78.6% of the recreation use in Region 3, and the majority of these users are Region 3 residents.

Recreation Resources. Since most of the use by Region 3 residents is on a day use basis, only the outdoor recreation resources available within a 50 mile radius of Colstrip will be discussed in detail.

Similarly the urban recreation resources discussion will be limited to Colstrip and Forsyth.

Outdoor Resources. Outdoor recreation resources are fairly numerous and varied within the day use area. Major attractions include Custer Battlefield National Monument; the Custer National Forest (Ashland Division); portions of the Tongue, Bighorn, and Yellowstone Rivers; and a number of historical sites.

A wide variety of use opportunities are available. Some of the most valuable are hunting for deer, antelope, upland birds, and waterfowl; warm water fishing; floating the rivers; collecting moss agates (local semi-precious stone); and visiting historical sites. No specific data is available for determining actual use of the recreation resources in this area.

Developed facilities include 28 camping units, 25 picnicking units, 1 swimming area, 1 boat ramp, and 4 fishing access sites.

Urban Resources. The towns of Forsyth and Colstrip are the only urban areas within the day use area. Both contain a variety of athletic fields, play grounds, swimming areas, etc., which are considered generally adequate for the immediate and near future needs of the residents.

Table 2-8

URBAN RECREATION FACILITIES

Facility	Forsyth	Colstrip
Outdoor Ice Rink	3	1
Outdoor Track*	0	1
Football Fields*	1	1
Baseball Fields	1	2
Outdoor Basketball Courts	1	0
Indoor Basketball Courts	1	1
Indoor Volleyball Courts	1	1
Golf Courses	1	0
Outdoor Tennis Courts	2	3
Outdoor Swimming Areas	1	1
Wading Pools	1	1
Meeting Rooms*	Many	2
Tot Lots	0	2
Boating Facilities**	1	1
Playgrounds*	4	4
Picnic Areas*	2	1
Rifle Range	1	1
Bowling Alley	1	0
Gymnasium*	0	1
Craft Rooms*	0	1
Handball - Paddle Ball Courts*	0	2

* Under construction in Colstrip. Most of these facilities are to be included in a community building.

Socio-Cultural Interests

Cultural Values

Archaeological and Historical Summary (see Appendix 2, Figure 11; Table 12; and Figure 12).

Ethnographic Sketch (see Appendix 2, Figure 13).

Paleontology. There are no fossils characteristic to the Tongue River Member in Montana. Plant fossils are found in the shales and clinker, but significant paleontological specimens probably do not exist in the mining area.

Description of Known Cultural Resources

Archaeological Reconnaissance and Excavations in the Mining Area. The cultural resources of the mining area and the surrounding region were little known prior to 1970. Energy development proposals and road construction since 1970 have produced several archaeological surveys and a few excavations (see Bibliography in Appendix 2, Table 13).

This work has yielded some tentative speculations about the movements of peoples in and around the mining area. The data has also been used to formulate hypotheses about aboriginal use of the area resources and the land use patterns developed by past inhabitants (Fredlund and Fredlund, 1974; Haberman, 1973; and Beckes, 1974). However, insufficient data is yet available to generate reliable archaeological models for the entire area.

Determinations of the age of archaeological sites recorded were based primarily on artifact typology. There have been reported some Early Prehistoric material (Fredlund, 1972b), substantial quantities of Middle Prehistoric sites (Davis, 1975), and many Late Prehistoric sites (Fredlund and Fredlund, 1974) in the area.

Two archaeological surveys were conducted on tracts which include all of the Western Energy Company Mining Area A (Fredlund, 1972a; Fredlund and Fredlund, 1974). The 1974 report has a chapter on historic sites, mostly old homesteads, none of which lie within Area A.

Cultural Resources on the National Register of Historic Places. No cultural resource located in the mining area is currently on the National Register of Historic Places.

Cultural Resources Determined to be Eligible for Placement on the National Register. No cultural resource in the mining area has been determined to be eligible for placement on the National Register (see Appendix 2, Figure 14).

Cultural Resources Determined to be Ineligible for Placement on the National Register. Four prehistoric archaeological sites in Mining Area A have been determined ineligible for the National Register (see Appendix 2, Figure 15, for explanation of types of archaeological sites reported below).

Ellison Petroglyph Site (24RB1019). This is a rock art site located in Sec. 31, T. 2 N., R. 41 E. It consists of four petroglyph panels etched in the vertical face of a sandstone outcrop (see Appendix 2, Figure 16, for complete site description).

Ellison Rock Site (24RB1020). This is a "habitation" site also located in Section 31, T. 2 N., R. 41 E. It may or may not have been associated with 24RB1019. One of the artifacts recovered from the surface of this site is a small side-notched projectile point (arrowhead), which may date from the Late Prehistoric Period (see Appendix 2, Figure 16, for complete site description).

Farley Ridge Site (24RB1022). This site is located in Sec. 5, T. 1 N., R. 41 E. and is reported as a "surface lithics" site (see Appendix 2, Figure 16, for site description).

Western Energy Shelter (24RB1033). Located in Sec. 32, T. 2 N., R. 41 E., this is a "surface lithic" site. Only lithic debris was found on the surface, but historic items were recovered from the excavation of the area inside the rock shelter (see Appendix 2, Figure 16, for site description).

Evaluation of Known Resources

The Ellison Petroglyph Site meets several of the criteria which give it a relatively high archaeological value. Panel four of the petroglyph is atypical of other rock art in the area (Fredlund, 1972a). This apparently unique panel is etched in very soft sandstone. An examination of panel four in 1973 revealed that it had deteriorated badly since the 1971 survey (Fredlund, personal communication). Fredlund speculates that blasting from the Western Energy and Peabody mines and sonic disturbances from aircraft may account for this deterioration. Although unique, panel four is not now well preserved.

Stuart Connor, an amateur archaeologist from Billings, Montana, was consulted about the archaeological value of the Ellison Petroglyph Site. Mr. Conner is recognized by amateur and professional archaeologists as a leading authority on rock art in southeastern Montana. He stated that while panel four is unique, it is of limited research value in that it cannot be related to rock art elsewhere. However, he finds panel one to have a high archaeological value. Horse figures on this section of the petroglyph have arrows touching the animals' backs, a configuration not observed elsewhere by Mr. Connor. Portions of panel one can be related to other rock art in the area.

Fredlund reports panel one in good condition in 1973. Etched in hard sandstone, this panel is more resistant to environmental disturbance. Panel one may yet be well preserved, it has a unique aspect, and it may be destroyed by mining operations. Panel one also has aesthetic value as do most rock art sites.

The Farley Ridge Site and the Western Energy Shelter yielded only small amounts of surface lithic (stone artifact) debris. Recent cultural material was recovered from the excavation of the rock shelter portion of the Western Energy Shelter. Further archaeological examination of these two "surface lithic" sites does not appear warranted.

The survey of the Ellison Rock Site produced a side-notched projectile point from the site surface and a 25 square foot test excavation yielded another point, three scrapers, and a hearth. The area of the site as indicated by sparsely scattered surface lithic debris is about 50 yards by 25 yards (personal communication, Lynn Fredlund).

Complete excavation of the Ellison Rock Site may be warranted. Further archaeological investigation could possibly reveal more hearth areas with enough charcoal to date the site or some of its components by the carbon 14 technique. Also, excavation of this site may help explain possible cultural affiliations between the Ellison Rock Site and the contiguous Ellison Petroglyph. At least one rock art site in Montana had subsurface artifacts at its base in the form of caches or "ceremonial offerings." That portion of the Ellison Rock Site below the art panels of the Ellison Petroglyph has not been fully excavated to determine the presence of such caches.

During any archaeological survey, no matter how intensive, some sites may not be located. Vegetation in some areas may cover surface evidence of cultural resources. Cultivated lands similarly may obscure sites, and there is always the possibility that cultural material is entirely subsurface in some regions.

Social Welfare and Economics

The mining of Area A has had socio-economic impacts on the towns of Colstrip and Forsyth, Rosebud County, and the State of Montana. The mining most directly affects Colstrip, Forsyth, and Rosebud County. It is primarily these areas which are described in terms of present socio-economic environment and probable impacts.

Unless otherwise noted, the data for this report came from the Southeastern Montana Socio-Economic Profiles, State Regions 2 and 3. The data are located in the State Office, Bureau of Land Management, Billings, Montana.

Population

Rosebud County lost 2.5% of its population through the 1960-70 period. The population in 1960 was 6,187; in 1970 it was 6,032. The county had a high percentage (74.9%) of rural non-farm population in 1970. This reflects that the county lacked communities classified as urban. The farm population made up about 25% of the total population in 1970. One of Rosebud County's rural non-farm population centers is Colstrip, which had a population of 75 in 1970 (Mountain West Research Inc., 1975).

Since 1970, Rosebud County and Colstrip have increased in population due to coal development. The county is estimated to now have a population of about 10,000. Colstrip had 3,200 residents in the summer of 1975.

Rosebud County's non-white population was 29.3% of the total in 1970. Almost all of this minority segment is Indian.

Industry, Income, and Employment

Rosebud County had 390 farms in 1969. Two hundred thirty-four of these farms totaled 1,000 acres and over. The value of agricultural products sold from the county in the same year totaled $2,204,200 from crops and $10,445,098 from livestock, poultry and their products. Crop production alone in 1971 totaled $3,576,100.

The 1972 value of mineral production for Rosebud County was $16,920,000 (includes coal, petroleum, sand and gravel, clays, and stone). The county's 1973 value of oil and coal production alone totaled $18,927,380.

The 1972 value of sales in trades, services and manufacturing for Rosebud County are listed below.

	Number of Establishments	Total Sales
Wholesale Trade	11	$ 2,760,000
Retail Trade	74	$10,411,000
Services	56	$ 988,000
Manufacturing	4	undisclosed

The median family income of Rosebud County in 1970 was $6,717. This was $1,795 less than the state figure of $8,512. However, the percentage of population with less than $3,000 is smaller than the statewide level and the county percentage of population with incomes

over $10,000 is greater than the state's. Also, the 20% proportion of Rosebud's population below the low income level was almost twice that for the state's 10.4% (Mountain West Research Inc., 1975).

Rosebud County per capita income for 1973 was $4,724 while the state figure was $4,626.

The total labor and proprietors earnings for Rosebud County in 1971 was $18,139,000. Contributions of various economic sectors to the total earnings are listed below:

Economic Sector	% of Total Earnings
Farm	34.8
Mining	*
Manufacturing	*
Construction	1.2
Government	16.7
Trans., Comm., Public Utilities	11.5
Wholesale/Retail Trade	7.6
Finance, Insurance, Real Estate	0.9
Services	14.0

* undisclosed

Figures for earnings were not available beyond 1971. Energy-related development in the county since 1971 has probably changed the above contributions significantly in the mining and construction sectors.

The most recent data available on Rosebud County labor and employment is also from 1971. The employment pattern for that year is listed below, and again, energy related development since 1971 has probably changed the pattern.

Sector	Number Employed
Farm	134
Mining	*
Manufacturing	*
Construction	25
Government	460
Trans., Comm., and Public Utilities	208
Wholesale/Retail Trade	238
Finance, Insurance, Real Estate	25
Services	400

* undisclosed

The 1973 unemployment rate for Rosebud County was 9.9% as compared to 4.6% in 1970. The estimated rate of unemployment in January, 1976 is 8.5% to 9.0% due to recent layoffs of construction workers at Colstrip (personal communication, Montana State Employment Service, Miles City).

Public Finance and Tax Base

The 1974 assessed property valuation for Rosebud County was $71,282,308 and the taxable valuation was $25,666,296. Levied property taxes totaled $3,540,890 for the same year. Property taxes levied according to purpose are shown below:

Purpose	Property Taxes Levied, 1974
State	$ 260,417
County	$ 912,961
School	$1,710,841
Special District and Misc.	$ 476,561
City and Town	$ 180,110

The total 1974 average mills levied in the county for state, county, and school purposes were 108.10. Total mills for county purposes were 34.38 and for school purposes were 67.72.

Infrastructure

Rosebud County had 2,055 housing units with an average of 3.3 persons per unit in 1970. Two hundred fifteen of these units were listed as vacant year-round and 23 were seasonally occupied.

Developments over the past five years have created a serious housing shortage in the county and in Colstrip. It appears that the lack of available financing has been a major factor in the housing lag. In attempting to cope with the shortage, the number of mobile homes has greatly increased (Mountain West Research Inc., 1975).

In July of 1975, Colstrip still had a severe housing shortage. The town had 170 houses, 64 apartments, and 158 mobile homes. An additional 624 trailer spaces and a dormitory for 270 construction workers were rented by the Bechtel Corporation. Housing shortages in Colstrip have forced workers to live in Forsyth and other areas, spreading the housing problem throughout the region (Ibid.).

The number of persons enrolled during 1970 in Rosebud County schools was 1,496, slightly less than the figure for 1960. Since 1970 the number of students has risen greatly. The enrollments at Colstrip and Forsyth alone totaled 1,426 at the end of the 1974-1975 school year. Colstrip schools are severly overcrowded but maintain a good teacher-student ratio (Mountain West Research Inc., 1975).

The hospital in Forsyth has an 18 bed capacity with a 47 bed nursing home adjacent. The hospital serves Rosebud and Treasure Counties. The facility is modern but lacks an adequate number of

physicians. The hospital staff includes a full-time doctor, a semi-retired doctor, ten registered nurses, and three part-time consultants. Many residents go to Billings or Miles City for medical service. Rosebud County also has a public health nurse (Ibid).

A county ambulance service has one fully equipped vehicle and operates primarily with volunteers who have had emergency medical training. It is reported that another ambulance is needed. Western Energy Company has an ambulance and two first aid trailers in Colstrip. Each of the trailers is staffed with a registered nurse. Bechtel Corporation also maintains an ambulance (Ibid).

There is one dentist in Forsyth, and a psychiatrist is available two days per week.

The Rosebud County Sheriff's Department consists of the sheriff, an undersheriff, and 11 deputies with 9 patrol cars. The men are stationed around the County, with 3 deputies and 2 cars located at Colstrip. The only jail is in Forsyth; it has room for 12 persons. A new jail is planned for at Forsyth, but the sheriff believes a facility is needed at Colstrip. He also sees a need for 3 or 4 more men and another car (Mountain West Research Inc. 1975).

Recent concrete data on the crime rate is not available, but it is known that Rosebud County is experiencing an increase in the number of offenses. The sheriff estimates a 40% rise in the crime rate over the last 3 years. Crimes appear to be increasing in all categories (Ibid).

The Rosebud County Sheriff's Department also serves as an operation headquarters for a volunteer fire department. Equipped with three sporadically available spray trucks, two fully available 6 X 6 army surplus trucks, and smaller items, the volunteer force is dispatched around the county. Colstrip has an 18 man volunteer fire department and a 1938 pumper truck which presently serves only the town area. Forsyth has three trucks, but the water supply is insufficient to maintain flow and pressure to give the community an insurance rating above class seven (Ibid).

Colstrip is supplied water from wells and the Yellowstone River. The present 1.4 million gallons per day capacity is adequate to serve the community. Forsyth uses Yellowstone River water which is treated in a plant now only marginally adequate at 1.5 million gallons per day. The water distribution systems are adequate in both communities (Ibid).

Forsyth's sewer system is inadequate and plans have been made for improvements. Land purchases have hindered expansion of the present facility. The sewer system at Colstrip has not yet been evaluated for adequacy of treatment. Solid waste in both communities is buried in state approved landfills.

Recreation facilities in Colstrip are now limited to baseball fields, tot-lots, and a two acre "passive" park. A recreation center is under construction and a community recreation director has been hired for further planning (Ibid).

Traffic on Rosebud County's road system has increased since 1970. Highway 315 between Forsyth and Colstrip is one of the most heavily used

routes in the county. Carrying about 830 vehicles per day, Highway 315's surface has deteriorated badly. The county currently tries to patch holes but a new surface is needed. Plans for improving Highway 315 are being formulated with the use of Coal Mine severance tax money. The state proposes to have this road and others in the coal area improved over the next five years. (Mountain West Research Inc.)

Forsyth has east-west Greyhound bus service daily. A commuter bus operates daily between Forsyth and Colstrip. Passenger rail service is available three days per week in Forsyth for east-west travel. An airport is available for small private and charter planes at Forsyth (Ibid).

Public Attitudes Toward Development

Several studies have attempted to determine public attitudes toward energy development. The 1974 study by the Montana Department of Natural Resources on the impact of Colstrip generating Units 3 and 4 considered the opinions of Rosebud County and Colstrip residents. The discussion presented below is synthesized from that study.

The results of the Department of Natural Resources public opinion survey are presented according to the occupational categories of the persons answering the questions posed by the researchers. An examination of the survey results indicates a division of opinions among Rosebud County residents on certain coal development issues.

For example, construction workers typically look more favorably upon further coal development than do local ranchers. The business community appears to have been fairly evenly divided.

About 30% of those surveyed believed further development should be confined to mining and exporting of coal. More ranchers (50%) and businessmen (30%) favored this alternative than the option of no further development whatsoever. Forty percent of manual construction workers favored unrestricted development to other alternatives.

Another issue considered was the local costs of industrialization in terms of added expense for law enforcement, public health, education, etc. Most of the people surveyed felt some combination of industry, government, and those who benefit directly from the coal should pay the costs. Ranchers were more inclined to want industry to cover these costs than were other groups.

A large number of ranchers believed that coal development would probably use water at the expense of crops. Most persons in other occupational groups did not feel water would be sacrificed from agriculture in favor of coal development.

Construction workers thought the beauty of the area around them was less important than did ranchers and businssmen. Construction workers also had a lower opinion of the quality of local police protection than did other occupational groups.

Most people in the sample agreed that the quality of education in the county was excellent. However, the ranching community was about evenly split on the educational quality issue.

On some matters all groups generally concurred. Most people felt there was a housing problem, that medical care was inadequate, that road quality was poor, but that the area was a safe place to live.

The length of time people had resided in the area was also shown to be a factor in the opinions expressed. Those who had lived there longer tended to be less favorable toward energy development. It also appears that some questions such as, "Who is to pay for community development required as a result of industrialization?" are highly inflammatory issues. Persons who believe that industry should pay the bill may be against other alternatives. It is the depth of feeling of those who hold extreme views on each side of the issues that was not expressed in the survey.

CHAPTER 3

ENVIRONMENTAL IMPACTS

For the purpose of this analysis, short term impacts are those resulting from on-site project activities up to and including 5 successive years from any point in time. Long term impacts are those extending beyond this initial 5 year period.

The impact analysis ratings (see Appendix 3, Figures 1 and 2) varied in relation to the resource being analyzed. For instance: One perspective and impact rating might be assigned to strip mine spoils viewed from within a mine by a mining engineer, while a different perspective and impact rating might be assigned to the same spoils when viewed from the air by a landscape architect. Likewise, impact ratings for wildlife may vary from highly beneficial to strongly detrimental for the same operation depending upon the season of year or the environmental protection measures incorporated in the project.

The relative area size considered in the analysis depended on the time period of impact. As proposed, the mine is expected to disturb approximately 120 surface acres per year when operating at full capacity. Although reclamation would follow mining as soon as possible, roughly 360 acres would be in a disturbed, unreclaimed state at any one time. Over the short term (5 year) period approximately 600 acres would be disturbed and part of this acreage would be reclaimed. For the sake of long term impact analysis the entire area (approximately 2,000 acres of actual mining area) was considered.

For this analysis, two implementation stages are analyzed. These are (1) mining, and (2) reclamation. The impact of mining coal within the lease modification area was considered separately from other mining in Area A for analysis purposes. In other words, the "Continuation of Mining without Lease Modification" alternative actually entails mining 2,000 acres of Area A. The "proposed action," or Continuation of Mining with Lease Modification, refers only to the proposed mining in the lease modification area (even though the discussion may refer to the similarity of impact in all of Area A). The impacts during reclamation for (1) Continuation of Mining with Lease Modification, and for (2) Continuation of Mining Without Lease Modification, are considered functionally and effectually the same. In other words, reclamation for the remainder of Area A will take place regardless of BLM action on the proposed lease modification within Area A.

Both mining and reclamation stages, and the discrete actions within each stage, are considered independently during the analysis. Also, during impact analysis, no mitigating measures other than those required by law, were considered.

Usually, the present environment would be considered neutral, and any movement from neutral would be considered a positive (beneficial) or negative (adverse) trend. For the purposes of this analysis, this is the case during the mining stage. However, during the reclamation stage, the condition following mining (prior to beginning reclamation) is considered neutral, and any movement from this "new" neutrality

would be considered a positive (beneficial), or negative (adverse) trend. Thus, whether the environment is returned to its "original" condition, is not considered in the impacts analysis, but it is considered in the ELU matrix (see Appendix 3, Figure 2).

Appendix 3, Figure 1 contains the analysis work sheets which were used to rate the expected impacts in magnitude and whether they would be beneficial or adverse. The ratings (L, M, H, or insignificant) are ordinal in nature, and based on a consensus of the specialists preparing the document.

The rest of this chapter is devoted to a discussion of the impacts brought to light during the analysis. The analysis evaluated the effects on the environment of each discrete operation within the stages of implementation as identified in Chapter 1. Chapter 2 establishes the present environmental situation impacted by the action.

NON-LIVING COMPONENTS

Air

Air Movement Patterns

Mining.

Continuation of Mining Without Lease Modification. (Throughout this chapter, the "Continuation of Mining Without Lease Modification" alternative refers to the continued mining of 2,000 acres of coal in Area A.) Two discrete operations will have impacts on air movement patterns.

Removal and stockpiling of topsoil will remove vegetation. If ELU's with shrub and tree cover are destroyed, air movements in, around, and through the higher order vegetative types will be affected. The two most important ELU's in this regard are 2b - Mesa-Butte Steep side slopes - Xerophytic Forest, (MBSS-XF) and 4c - Dissected Mid Slopes - Xerophytic Forest (DMS-XF). The impacts would affect the micro climate only. General air movement patterns would receive no impact.

The removal of the overburden will also impact air movement patterns in the immediate area. The surface air, with normal changes in temperature, follows the topography. Changes in the landform resulting from removal of the overburden will change the direction and flow of air to follow that of the spoils (overburden piles) rather than the natural land form. This impact will be very limited, but long term in duration.

It will not occur for a long time at any one point (due to reclamation), but the impact will shift with the mining operation. Revegetation of this area will be influenced by the air movement patterns created because many species rely on wind movement for seed dispersal. The ELU's that will be most affected are those with steep topography such as Mesa-Butte Steep Side Slope - Xerophytic Forest. Wind movement through this ELU changes with temperature throughout a 24 hour period. Very little acreage of this ELU is present, thus the impact would be relatively unimportant. If the 320 acres are not mined, the changes will not take place on that area unless spoiled on during the mining in the rest of Area A.

Continuation of Mining With Lease Modification. With the lease of the subject 320 acres, the impacts of topsoil removal and stockpiling and of overburden removal would be the same.

Reclamation. (Throughout this chapter, this stage begins from the condition following mining.) The impacts on air movement patterns will all be favorable because a rolling landform will be replaced. This topography could not duplicate the exact condition prior to mining, but will approximate similar conditions. However, ELU's with forest cover may take over a hundred years to re-establish. The impacts will affect micro climate only (limited primarily to forested ELU's), and as a consequence will not significantly change general air movement.

Air Temperature

Mining.

Continuation of Mining Without Lease Modification. The removal and stockpiling of overburden will result in the most marked change in surface air temperature, because the air temperature will increase. Those ELU's with tree and shrub vegetative cover, such as Mesa-Butte Steep Side Slope - Xerophytic Forest, Dissected Mid Slopes - Steppe Shrub, Dissected Mid Slopes - Xerophytic Forest, and Alluvium/Terrace - Steppe Shrub would experience the greatest increase. The vegetation shades the surface, thus modifies surface air temperatures. This impact will be limited to the micro climate. For some trees and shrubs, this shade modification of temperature may be a critical factor in regeneration. Given time, and the establishment of pioneer stands of less temperature sensitive vegetation, conditions needed for re-establishment of temperature sensitive vegetation will recur. These impacts would not be felt on the 320 acres unless portions were spoiled on.

Continuation of Mining With Lease Modification. Under the proposed action, the impacts described would be extended onto the additional 320 acres.

Reclamation. The revegetation operation will result in beneficial impacts on air temperature. The tree and shrub cover will take a long time to replace, possibly as long as one hundred years. The vegetation will act as a buffer against extremes of temperature on micro-sites and will facilitate the establishment of successionally more advanced vegetative types suitable to those sites. General air temperatures throughout the area will not be impacted by the action.

Particulate Matter

Mining.

Continuation of Mining Without Lease Modification. Particulate matter will increase during all discrete operations. It is unknown whether it would meet State and Federal regulations. The result will be a decline in air quality near the mine. Dust will be produced as long as the mine is in operation. Each discrete operation (except transportation, delivery, and crushing) will result in very low levels of increased dust. Transportation, delivery, and crushing will produce a long term adverse impact in that this operation will be the primary source of fugitive dust in the area. The major importance of the increased dust will be respritory nuisance and visual detraction.

Continuation of Mining With Lease Modification. There would be no change in impacts with the lease modification.

Reclamation. Regrading will result in adverse long term impacts. Dust will be increased while spoil is being moved by equipment and by wind action on the regraded spoil piles. The impacts will be recurring for the duration of the mine.

Topsoiling will also be a source of increased dust, resulting in a detrimental impact for the duration of mining. Topsoil will be emplaced only during the summer months; thus the impact will be seasonal and repetitive.

Revegetation will result in a beneficial long and short term impact on particulate matter. Revegetation will reduce the movement of particles from the reclaimed area.

Exhaust

Mining.

Continuation of Mining Without Lease Modification. Exhaust emissions, such as carbon monoxide and nitrous oxide, will be produced from any internal combustion engines used in the mine. This will result in an adverse impact because air quality close to the operating equipment will deteriorate.

Continuation of Mining With Lease Modification. The exhaust emissions that would result from the mining of the additional federal coal would be insignificant.

Reclamation. All discrete operations in the reclamation stage of implementation would create additional exhaust emissions. The level of increase would be insignificant. Following successful reclamation of the entire mine, no impact would be experienced from exhaust gases.

Land

Soil Depth, Soil Structure, Soil Nutrients, Soil Pollutants, and Soil Erosion

Mining.

Continuation of Mining Without Lease Modification. The removal of approximately 2,000 acres of topsoil in the portion of Area A already being mined will have a severe adverse impact on soil depth both in the short and long term. A detailed soil survey in Appendix 2, Map 1, shows where topsoil ranging from 0 to 60 inches in depth will be removed. These soils will then be respread over the regraded spoils at a uniform depth.

Soil structure which is the arrangement of the soil particles will receive a like impact from topsoil removal. Removing the topsoil will destroy the original arrangement of the particles, and a homogenous soil mixture will be replaced over the regraded spoils.

Topsoil removal will have a severe detrimental impact on soil nutrients. Removing the topsoil breaks the nutrient cycle (storage structure and nutrient balance). The breaking of this previously closed nutrient cycle makes additional nutrients temporarily available for plant use, but percolation and loss through surface water soon removes the released nutrients. Thus, soil production capability will be reduced.

Colstrip area soils were formed primarily from sandstones and silty or clayey shales. There are no known saline or sodic soil series

in the proposed mining area. Thus the removal of topsoil and overburden will have no effect on soil pollutants.

Removal of topsoil will have an minor adverse effect on soil erosion both in the short and long term. The removal of topsoil alone will not cause soil erosion, but it will aid erosion by breaking up the topsoil and making it susceptible to other erosion agents during the topsoiling operation.

Stockpiling will have little effect on topsoil during the mining operation, because the only topsoil which will be stockpiled will be from the initial box cuts. This amount of stockpiled topsoil is insignificant when compared to the total amount of topsoil disturbed, but it will be set aside for a long period of time. The outer portion of the stockpile will retain only a portion of its nutrient properties and productivity, and the inner portion will lose all nutrient properties and productivity. Some wind and water erosion will also occur on the outer portion of the stockpile until revegetated. In general the mining operation will lower the level of soil productivity until such time that soil structure and soil nutrient cycles are re-established.

Continuation of Mining With Lease Modification. The leasing of the additional 320 acres would have only slight additional accumulative impacts on the total project. Thus the impacts and rationale are essentially the same as the "Continuation of Mining Without Lease Modification alternative."

Reclamation

Regrading has a beneficial effect on soil erosion. Proper regrading of spoil piles creates physically stable slopes, reduces erosion, and makes it possible to utilize the proper equipment for surface manipulation and seedbed preparation.

Topsoiling has a highly favorable impact on soil depth both in the short and long term, because topsoil is replaced uniformly over the graded spoils. Prior to topsoil removal, soil depth varied considerably.

Topsoiling has a minor adverse impact on soil structure. The disarrangement of the soil particles occurred when the topsoil was removed. Although the replacement of the topsoil on the regraded mine spoils will further disrupt soil structure, the major impact occurred during topsoil removal.

Topsoiling will have a low adverse impact on soil nutrient properties both in the short and long term. The breaking of the nutrient cycle occurred when the topsoil was removed. Although the replacement of the topsoil will further disrupt the cycle, the major impact occurred during topsoil removal.

Topsoiling will have no effect on soil pollutants, and a low beneficial effect on soil erosion. The main impacts will be during regrading and surface manipulation. Topsoil will enhance plant survival and growth and thus tend to reduce erosion.

Revegetation would have no effect on soil depth beyond improving the chances of successful revegetation which would reduce erosion.

Revegetation will have an insignificant beneficial effect on soil structure. Soil structure will be determined by the material used for topsoil.

Revegetation will have a significant beneficial effect on soil nutrients both in the short and long term. Proper revegetation would restore the area to a state under which the vegetative cover and nutrient cycle are as closed as before the man-caused disturbance.

Revegetation will have no effect on soil pollutants.

Revegetation will have a significant beneficial impact on soil erosion. Revegetation will produce a plant cover which will protect the soil from both water and wind erosion.

Geologic Structure

Mining.

Continuation of Mining Without Lease Modification. Significant impacts will occur to the geologic structure during the overburden removal, blasting, and excavation, and the loading stages of the mining operation. Once the overburden and coal are removed, this portion of the geologic structure is lost forever.

Continuation of Mining With Lease Modification. The overburden removal and subsequent stages of mining operation can be expected to have a significant impact on the geologic structure since the strata will be mined out.

Reclamation. The geologic structure is not expected to be impacted during the reclamation stage of operation with or without modification

of the lease. The geologic structure of the mined area will be destroyed during mining, and it cannot be replaced or re-established through reclamation.

Topography

Mining.

Continuation of Mining Without Lease Modification. A minor impact can be expected to occur on the topography during the topsoil removal operation, because the topsoil stripping operation will not drastically change the topographic expression of the area. However, a major effect is expected during the overburden removal phase of operation. Overburden removal by a dragline to depths as great as 175 feet will radically change the natural topography. The blasting-excavation, and transportation operations will remove an additional 25 feet, increasing the maximum rock removed to about 200 feet within the working area at any given time.

Continuation of Mining With Lease Modification. The topsoil removal operation will have a minor effect on the topography because the removal of these thin soils will not drastically change the topographic expression of the area. A significant impact to the topography is expected to ensue during the overburden removal stage since the natural topography in the subject 320 acres will cease to exist. The removal of the 25-foot coal seam will be an additional, but insignificant, impact on the already impacted topography.

Reclamation. Regrading the spoils will have a major beneficial impact on the topography because the topography will be partly re-established. The reclaimed topography will consist of lower sloped landforms more adaptable to agricultural uses. The steep-sloped and related landforms will not be put back.

Topsoiling and reseeding will have indirect but beneficial impacts on the topography. These operations will reduce the rate of erosion on the reclaimed topography.

Land Use Suitability and Compatibility

Mining.

Continued Mining Without Lease Modification. The quantity and quality of coal, depth of overburden, and terrain makes most of Area A suitable for strip mining. The exception is the center of Area A which has overburden in excess of that which can be economically removed at this time.

Strip mining as an activity is both visually and physically incompatible with the past land uses. Mining appears out of place in relation to farming and ranching. The land being mined will be physically unusable for these uses as well, until it's reclaimed.

From the point of view of mine development, continued mining without the lease modification will also be incompatible. This action would make mining and reclamation more difficult and therefore more expensive. It would also result in the nonuse of 12.6 million tons of coal. If bypassed, however, and left unspoiled upon, the 320 acres could still be used for ranching.

Continued Mining With Lease Modification. From the point of view of mining Area A, the lease of the 320 acres of Federal coal would be compatible with the mining operation. It would prevent the loss of the coal resource, and facilitate mining and reclamation following a logical plan. Also, strip mining will occur on at least three sides of this 320-acre tract.

Reclamation. Reclamation is designed to make the land suitable for resumption of agriculture; therefore, it will have a very significant beneficial impact. If the mine site is restored to a form similar to adjacent lands, a compatible relationship will be re-created. The reshaped and topsoiled mined land may be more suited to farming because the slopes may be gentler and more uniform (by law the land cannot be reclaimed to greater than 5:1 slopes).

Water

Removal of the topsoil and the subsequent removal of the overburden and coal would affect the water resources, but the magnitude of the impacts would be low or unknown. The Rosebud coal bed and overburden in Area A are not significant useable aquifers. The impacts that would occur in Area A would be neither increased nor decreased without the lease of the 320 acres.

Hydrologic Cycle

Mining.

Continuation of Mining Without Lease Modification. Removal of the topsoil will have a minor impact on the hydrologic cycle. The soil-moisture and root zones will be lost. Removal of the topsoil will eliminate its "blotter" effect. Water will no longer be available for later downward movement or upward evapo-transpiration. Instead, it will percolate downward almost immediately toward the overburden, it will accumulate in undrained depressions as ponded water and be available for evapotranspiration, or it will be discharged from the area as surface runoff. Precipitation will be discharged more rapidly to groundwater, to surface streams, or to the atmosphere. The part that goes to groundwater will be discharged in the valley of Armells Creek.

The overburden denuded of vegetation and topsoil will be exposed in a linear band above the highwall of the mine for a short time. Removal of the overburden will create a trench. Precipitation, surface runoff from adjacent hillsides that slope toward the mine, and any groundwater

in the overburden will accumulate in the trench. The water will either be pumped out, seep into the underlying or adjacent strata, or move into the base of previously deposited spoil material.

Blasting, excavating, and removing the coal will have a minor impact on the hydrologic cycle, because in the pre-mining environment, the coal bed dips very gently to the southeast, and water in the coal is discharged along the south-facing slopes above Armells Creek. Excavation would reduce the length of the aquifer and increase the rate of dewatering.

Of the three wells identified in Area A, only the water source of one well will be affected by mining. Its source is the Rosebud clinker (overburden). The effect is predicted to be only a moderate seasonal loss of use (Van Voast and Hedges, 1974). Mining should not affect the other two wells' water source since they tap aquifers well below the McKay coal seam.

Continuation of Mining With Lease Modification. The impacts of mining the proposed additional coal would be similar to those described above (mining throughout the remainder of Area A without the lease modification).

Reclamation. Reclamation may have significant impacts on the hydrologic cycle in Area A. Replacement of stratified rocks by broken and unsorted material will make more space available for collection and retention of subsurface water.

The emplacement and regrading of the spoil material in the strip pit will provide porous debris beneath a land surface more gently sloping

than the original. Water will move over the surface as runoff more slowly than it does at present, and the increased porosity and vertical permeability of the replaced overburden could promote increased accumulation of groundwater. This action is the first step of reclamation, however, and the reshaped bare spoils will be exposed for only a short time, measurable in months.

Topsoiling will alter the rate of infilitration by interposing a layer of fine-grained material over the spoil. The soil would have to be nearly saturated before it would transmit water to the underlying spoil material. Topsoiling will be followed in a matter of weeks by seeding and revegetation. The re-establishment of vegetation could reduce infiltration by withdrawing water from the soil-moisture zone. The soil-moisture deficiency thus produced would have to be satisfied before downward movement of water could proceed. Vegetation could also limit surface runoff by reducing the amount of water available.

Sediment Load

Mining.

Continuation of Mining Without Lease Modification. Removal of topsoil will increase sediment load because the exposed rock materials are subject to erosion, but most of the runoff and sediment go toward the strip pit. The amount of material moved varies with the time between topsoil removal and overburden removal and also with the time of year during which the overburden is exposed.

Removal of the overburden adds little to the sediment load. Runoff cascading down the highwall and the ends of the freshly opened cut carries

sediment to the pit. This impact is of short duration but is repeated for each cut throughout the life of the mine.

Continuation of Mining With Lease Modification. The impacts of mining the additional coal would be similar to those described immediately above.

Reclamation. Regrading of the spoil presents unconsolidated overburden at the top of the pile and makes it available for erosion. Sediment is moved if precipitation occurs during the interval between shaping of the spoil bank and topsoiling. Part of the sediment goes to the active part of the mine, and part goes toward older revegetated spoil banks and the valleys of Stocker and Armells Creek. Topsoiling and revegetation of the regraded spoil piles will have variable impacts on sedimentation. The topsoil will be available for movement by wind and water until the vegetation becomes established and the plant roots and humus reduce the amount of sediment that can be removed.

Chemical Content

Mining.

Continuation of Mining Without Lease Modification. Removal of topsoil impacts the chemical content of both surface runoff and groundwater. The topsoil is an interceptor of water, and with its removal, water that had been surface runoff or had been trapped in the soil zone for transpiration is available to percolate into the overburden. Precipitated minerals in the overburden are exposed to re-solution by snowmelt and rainfall.

The effects of topsoil removal on heavy metals, toxic substances, or nutrients in the overburden are not known but are presumed to be slight for the following reasons: (1) The water that percolates through the overburden is limited to the precipitation that falls into the new cut after the topsoil is removed and before the coal is exposed. The time involved normally would be a matter of a few months, (2) the solubilities of heavy metals, toxic substances, and nutrients are variable, and (3) many of the heavy metals are identified only as trace elements in solution (neither the minerals that contain them nor the quantities present have been determined).

Continuation of Mining With Lease Modification. The impacts would be similar to those discussed immediately above.

Reclamation. Regrading of the spoil banks would place minerals in a position to be dissolved at the surface, but the subsequent retopsoiling and revegetating would reduce the amount of water that could reach them.

LIVING COMPONENTS

Aquatic Vegetation

Vascular Plants

Mining.

Continuation of Mining Without Lease Modification. An intermittent stream (East Fork Armells Creek) and two small stock ponds were the only significant aquatic habitat identified in Area A. The two stock ponds lie within the coal "take-line," but the Armells Creek channel is not apt to be mined. Therefore, due to the small extent of area affected, an adverse impact of minor importance occurs during the topsoil removal stage. Once the topsoil is removed, the substrata for support of aquatic vascular plants is gone, and with it, the plants too. Mining activities adjacent to wetlands may cause dust settlement on aquatic plants, thus adding to the impact on vegetation. Excessive quantities of dust accumulating on aquatic vegetation may interfere with their normal physiological processes.

The impact on aquatic vascular plants is total and final and therefore continues throughout the life of the mine, and thus, is identical for both the short and long term. More area will be affected in the long run. At any specific site, there is a complete loss of plants. Other discrete operations do not impact these plants.

The current flood plain ELU is the primary affected system involving aquatic vascular plants.

Continuation of Mining With Lease Modification. No significant aquatic vegetation is found on the E½ of Section 32, therefore, there would be no impact of leasing and mining on this 320 acre area.

Reclamation. The regrading operation would represent a beneficial impact on aquatic vascular plants *if* wetland basins were created; however, present state law does not normally provide for creation of wetland basins. If wetland basins were created, the topsoiling operation would provide a fertile substrata for aquatic plants.

Phytoplankton

The impacts of mining and reclamation on phytoplankton would closely parallel those for aquatic vascular plants. Therefore, the identical impact rationale applies to this environmental sub-component in both the short and long run for Area A at large, and the E½ of Section 32.

Floating Plants

Most floating aquatic plants require a relatively stable, permanent or semi-permanent pool as habitat. No aquatic habitat of this nature occurs in Area A, therefore, no impact on this environmental sub-component occurs.

Terrestrial Vegetation

Lichens and Mosses

Mining.

Continuation of Mining Without Lease Modification. The topsoil removal and stockpile operation has more effect on lichens and mosses than do other discrete operations. When the soil is removed, lichens and mosses and their habitat are destroyed. Since more area is affected in the long term, the importance of the impact is greater for this period. At any specific site, the lichens and mosses are destroyed. Since they are not the dominant vegetation of the area, however, the overall impact is lessened in importance. Changing the overall physiographic aspect of the land in the overburden removal operation, a further slight impact occurs on the lichens and mosses in both the short and long run. The remaining mining operations will not have any impact on lichens and mosses. Lichens and mosses are most common on the heavy soils occupied by the alluvium/terrace-steppe grassland and steppe shrub ELU's.

Continuation of Mining With Lease Modification. The loss of lichens and mosses resulting from the mining operations on the E½ of Section 32 is considered of lesser importance than the loss from Area A at large due to the comparative absence of the alluvium/terrace-grassland and shrub ELU.

Reclamation. The effect of reclamation on lichens and mosses is largely unknown. Lichens and mosses have not been considered for

reclamation since they are not particularly useful as forage for livestock and wildlife of this region. They might naturally reinvade a reclaimed area, but their pre-mining status is not likely to be attained.

Grasses and Forbs

Mining.

Continuation of Mining Without Lease Modification. The removal of topsoil destroys the essential supporting substrata for grasses and forbs. Mining activities may cause dust settlement on down wind terrestrial plants and thus add to the impact on them. Excessive dust on plants may interfere with their normal physiological processes. Since more area is affected with time, the impact is more important in the long term. At any specific point in location and time, however, the affect is total destruction of grasses and forbs. The dissected midslope-grassland, shrub, and pine forest ELU's will be most heavily impacted by this operation. In mining, the natural ELU's are replaced by the artificial mine spoil ELU.

Overburden removal will destroy topographic exposures, thereby, affecting the micro-climate (surface temperatures, moisture accumulation, etc.) with a detrimental impact on vegetation. The impact of overburden removal is not as severe as that of topsoil removal and thus was considered of lesser importance in both the short and long term.

Continuation of Mining With Lease Modification. Severity of the impact is the same for the mining of the E½ of Section 32 as for the rest of Area A, although a smaller area is impacted.

Reclamation. The regrading operation replaces a topography favorable for consistent range plant growth. Therefore, the impacts of this operation are beneficial to grasses and forbs in both the short and long run. A larger area is impacted favorably in the long term. The topsoiling and revegetation operations were considered highly beneficial in both the short and long term. Topsoiling would provide an immediate plant growth medium, and seeding would greatly accelerate the revegetation process. These impacts should be realized immediately (within one growing season) after initiation. The emphasis on reclamation in this area appears to be toward grass and forb species, although the pre-mining mixture of grass and forb species is not apt to be restored. The dissected mid slope-grassland ELU would be greatly benefited by revegetation.

Shrubs and Conifers

Mining.

Continuation of Mining Without Lease Modification. During the mining operations, shrubs and conifers are impacted in the same manner as grasses and forbs. The impacts rationale is also the same. The dissected mid slope-grassland ELU would be impacted to a lesser extent for shrubs and conifers than for grasses and forbs. The dissected mid slope-xerophytic forest would be impacted to a greater extent.

Continuation of Mining With Lease Modification. The environmental impact rationale for the E½ of Section 32 is the same as for the rest of Area A.

Reclamation. Most of the shrub and conifer complex occurs on steep slopes with very coarse soils. This soil-topography complex is critical to shrubs and conifers. This topographic complex will not be duplicated when the spoil piles are regraded. The replaced topsoil generally will be finer textured than the typical coarse soils of the steep slopes and may be a better growth medium (especially for plants other than shrubs and trees). If shrubs and conifers are planted and cared for until they become established, the impact will be significantly beneficial. However, the pre-mining shrub and conifer complex probably never will be completely duplicated.

Broadleaf Trees

Mining.

Continuation of Mining Without Lease Modification. The majority of broadleaf trees on Area A occur in the current flood plain-mesophytic forest ELU along Armells Creek bottom. This ELU lies largely outside the coal outcrop line and therefore, is not being mined. Broadleaf trees will be destroyed in the topsoil removal operation on any site where they are found within the coal "take-line". More area will be affected in the long term. Overburden removal could affect the drainage pattern and therefore the broadleaf trees. This operation represents a slight additional impact on broadleaf trees. None of the other mining operations are expected to contribute any additional impact on broadleaf trees.

Continuation of Mining With Lease Modification. The only broadleaf trees occurring on the E½ of Section 32 are accidentals. Therefore, topsoil removal would have only a slight impact on broadleaf trees. No other operations are expected to create a significant impact on them.

Reclamation. The regrading operation is not likely to create wetland basins. The importance of this impact is undetermined. Topsoiling, if conducted along a drainage or wetland basin (if present), is considered beneficial to wetland vegetation in both the short and long term by accelerating the revegetation process. Since the reclamation emphasis is not generally aimed at broadleaf trees, the revegetation operation was considered of minor importance. Following mining, broadleaf trees will probably not be found on Area A in their original sites.

Aquatic Animals

Mammals, Birds, Amphibians and Reptiles, Invertebrates, and Zooplankton

Mining.

Continuation of Mining Without Lease Modification. The destruction of the in-place topsoil support medium removes any opportunity for the existence of most significant aquatic habitat. Removing this habitat removes the aquatic animals (i.e., muskrats, mink, raccoons, etc.). None of the subsequent operations of mining are expected to have a further impact on aquatic animals. Since little aquatic habitat exists in Area A, the impact is of little significance.

Continuation of Mining With Lease Modification. No significant aquatic habitat, therefore no aquatic animals, occurs on the E½ of Section 32.

Reclamation. The discrete operations of the reclamation stage would be expected to have a beneficial impact on aquatic animals if wetland complexes were to be produced. The reclamation emphasis however, has been away from wetlands, so the impact of reclamation on aquatic animals is expected to be unimportant. Wetland basins could be created in the regrading operation; an aquatic vegetation substrate could be replaced with the topsoil; and revegetation with aquatic plants could assure the existence of aquatic habitat. Any aquatic habitat created, however, would differ from the pre-mining condition, and many years would probably be required to establish a stable and diverse wetland.

Fish

The occurrence of fish on Area A is undetermined. If fish are present, they would very likely be minnows in pools along Armells Creek, capable of withstanding severe stress and "draw down" conditions associated with an intermittent stream.

No fish habitat occurs on the E½ of Section 32. Therefore, fish were considered unimportant during this analysis.

Terrestrial Animals

Mammals, Birds, Reptiles, and Invertebrates

Mining.

Continuation of Mining Without Lease Modification. As the topsoil is removed, the terrestrial habitat is destroyed. This is a very significant detrimental effect on terrestrial animals (deer, cattle, songbirds, grouse, bull snakes, etc.) because all cover and food are destroyed. The effect continues throughout the life of the mine because the impact is repeated on successive areas. The overburden removal affects the relief of the land and thereby impacts the animals by changing their macro-environment. Blasting and excavation are not expected to impact terrestrial animals permanently. After initial alarm responses, wildlife are not expected to pay much attention to the mining noise or activities. Collisions between transient wildlife and coal haul trucks will be an adverse impact. This impact must be considered relatively unimportant, but it will continue for the life of the mine.

Continuation of Mining With Lease Modification. Environmental impacts to terrestrial animals on the E½ of Section 32 are the same as for the rest of Area A, but few additional animals would be disturbed since only 320 additional acres would be involved.

Reclamation. Regrading of the spoils banks creates a favorable topography for topsoil replacement and vegetative growth, and therefore is important to all major terrestrial animals. The topsoil replacement operation is even more beneficial because it provides a plant growth

substratum for revegetation. The new vegetation includes herbivore food plants. Soil invertebrates would be even more favorably impacted by topsoiling than are other terrestrial animals. The revegetation operation provides the habitat cover and food complex required by terrestrial animals.

Man

Man, as an animal, is expected to be detrimentally impacted by the topsoil removal operation, because a food source (cropland or rangeland) will be lost. This impact is relatively slight, however, because of the small area involved. The safety hazard to man during all the mining and reclamation operations is important throughout the life of the mine. Revegetation should restore the surface for man's activities and, therefore, has a beneficial impact.

ECOLOGICAL PROCESSES

Succession, Food and Community Relationships

Mining

Continuation of Mining Without Lease Modification. Topsoil removal immediately destroys the site vegetation and causes plant and animal succession and community relationships to regress. This immediate environmental impact is drastic and highly detrimental to the existing ecosystem. However, succession is a dynamic process and new vegetative establishment soon starts. Therefore, the long term impact is of lesser importance. The overburden removal operation changes the land relief and the potential vegetative climax. The impacts on food and community relationships are expected to parallel those of succession. None of the other discrete operations of mining are expected to have any significant impact on these processes.

Continuation of Mining With Lease Modification. Similar impact rationale applies to the E½ of Section 32 as for the mining of the rest of Area A.

Reclamation

The regrading operation creates a topography favorable for plant establishment. Topsoiling is important because it further enhances vegetation re-establishment. The revegetation establishes a plant successional stage and provides a basis for animal habitat. For these

reasons, revegetation was considered beneficial and important in both the short and long run. The impact rationale for food and community relationships in the reclamation stage are expected to parallel those for succession.

The exact conditions which created the present ELU's will never be duplicated after mining (see Appendix 3, Figure 2). The new ELU's created in reclamation should eventually balance, functionally, with adjacent unmined ELU's. The overall long term impacts of this new balance are unknown.

HUMAN VALUES

Aesthetics

Visual quality is the major factor in the aesthetic values of Mining Area A. The major portion of Area A, and the proposed lease modification, has been rated as Class B scenery according to BLM Manual 6310 procedures (see Appendix 2, Figures 9 and 10). Of the four major landscape elements (texture, line, form, and color), texture is the dominant element, closely followed by form and color.

Continuation of Mining Without Lease Modification

Visual contrast rating procedures described in BLM Manual 6320 (see Appendix 3, Figure 3) were used to determine the relative impacts of mining on scenic quality. Mining operations will create a strong visual contrast with present conditions. Reclamation will reduce this contrast. The reclaimed area will be lowered in scenic quality and have a moderate visual contrast compared to present conditions and/or unmined areas.

Mining operations create a major intrusion into the existing natural and relatively undisturbed landscape. The large equipment (trucks, bulldozers, draglines, etc.) will create an extreme contrast to existing conditions. Individual perceptions of this operation are largely divided between two extremes. Those in favor of mining are indifferent--"It's the only way to get the coal out." Those opposed to mining perceive it as catastrophic--"The entire area would be permanently

destroyed." It should be noted, however, that the majority of the viewers will be mine employees and their families. The mine area is visible from the town of Colstrip and is not on a major traffic route or near any high use recreation areas.

The major impact will result from the disturbance caused by topsoil stripping and the removal of overburden. Line and form elements will become dominant during mining operations. The line element will be very obvious at the boundary of the topsoil stripping area and will be repeated in the parallel rows of spoil material. A strong artificial form element will be created by the mine pit and the adjacent spoils. Existing texture and color elements will be diminished. The presence of equipment and increased dust levels will create additional visual disturbance and slightly increase noise and (possibly) odor levels.

Regrading the spoil piles to approximate the original surface configuration and revegetating them will reduce the evidence of man-caused disturbance. The form of the unmined portion will dominate the landscape. The sharp contrast between the relatively formless, smooth textured character after reclamation and the texture and form dominated unmined portions will create a strong new artificial line element. The overall scenic quality rating of the mined area will decline from Class B to Class C (see Appendix 2, Figures 9 and 10). The reclaimed land will have little variety, and no single landscape element will be dominant.

Continuation of Mining With Lease Modification

The impacts associated with the proposed lease modification would be identical to those described above expressed on an additional 320 acres.

Recreation

Continuation of Mining Without Lease Modification

The primary impacts on recreation will result from increased recreation use demands created by a larger population base associated with increased mine employment. No specific recreation use figures are available. This impact is based on a comparison of existing recreation activities and stated preferences in Chapter 2, Table 2-6 and the assumption that new residents will have similar preferences. The regional recreation demand for several activities already exceeds the supply. In recent years, increasing amounts of private lands have been closed to recreation use. This is partly a result of antagonism toward mining, increased numbers of recreationists, and existing or anticipated damage to land and property. Increasing recreation pressure may result in additional closures of private land.

Mining operations will reduce supply by removing Area A from recreation use during the life of the mine. Reclamation will eventually return the mined area to a condition suitable for general outdoor recreation use, but availability of the land for this use is conjectural because the surface is privately owned.

Continuation of Mining With Lease Modification

There would not be any increase in population and subsequent use demands associated with the proposed action. Mining the additional 320 acres would extend the life of the mine, and associated impacts, approximately three years.

Sociocultural Interests

Cultural Resources

Mining.

Continuation of Mining Without Lease Modification. The four known sites in the mining area have been recorded and evaluated (see Chapter 2). Any cultural material not located in the surveys may be lost due to removal and stockpiling of topsoil.

Shock waves from blasting may have an impact of undetermined magnitude on rock art sites if they are contiguous to the mining area. The deterioration of the Ellison Petroglyph's panel four illustrates the possible adverse effects of blasting on rock art sites (see Chapter 2). No survey has yet been conducted to locate possible rock art sites near the mining area.

Continuation of Mining With Lease Modification. If the lease modification is approved, soil removal and stockpiling would destroy whatever remains of the Western Energy Shelter (see Chapter 2). The impact of this action in the context of the total cultural resource values of southeastern Montana would be negligible, because the shelter portion of Western Energy Shelter has been excavated and recorded. The "surface lithic" area of this site does not warrant further archaeological work (see Chapter 2).

The impacts on rock art sites from blasting would not be changed if the lease modification is approved.

Social Welfare and Economics

The socio-economic impacts of coal mining are already occurring in Rosebud County (see same section in Chapter 2). Long term impacts have been speculated upon in other analyses pertinent to energy related operations in the area (Montana State Department of Natural Resources and Conservation, 1974). However, the future impact of coal development on the socio-economic structure depends on unresolved governmental and industrial decisions. The construction of additional power generating units at Colstrip may alter the current socio-economic structure significantly.

Mining

Continuation of Mining Without Lease Modification. Economic impacts of mining Area A are part of the impacts of the total energy developments planned. The 110 employees working in Area A earn $186,650 per month. A twenty year operating life is expected for all of Area A (personal communication, Western Energy). The entire mining operation at Colstrip (Areas A, B, C, D, E, and F) now employs 257 persons. A total work force of 425 is expected when all planned mining areas are functioning.

The social impacts of mining in Area A are difficult to isolate. The mining here has contributed to the present situation (see Chapter 2), however, it is impossible to discuss which social impacts were due to the mining of Area A alone.

Continuation of Mining With Lease Modification. The impacts outlined under mining without lease modification would be the same for the continuation of mining with lease modification with one exception: Lease modification would sustain the mining operation for approximately three additional years. This would have a relatively low socio-economic impact relative to total energy development in the area over a twenty-year period.

Reclamation

The success of the reclamation efforts may determine the usefulness of the mined land for future economic activities such as farming or grazing. The impacts, whether favorable or adverse, will be very significant to the economic well being of some people in the mining area.

Attitudes and Expectations

Mining

Continuation of Mining Without Lease Modification. Public opinion may be adverse toward bypassing some coal while mining the surroundings. It may be thought by many to be an unnecessary waste of the energy resource, because mining the bypassed coal after the surrounding land is reclaimed may not be economically feasible.

Continuation of Mining With Lease Modification. The public attitudes discussed under Attitudes and Expectations in Chapter 2 reflect local response to mining operations. Therefore, the continued mining of Area A should have a negligible impact on current attitudes, with one exception: The land considered in the lease modification includes approximately 120 acres which, according to BLM planning records, should not be leased due to conflicts with aesthetics, vegetation, and soil erosion susceptibility. The leasing of this 120 acres, without involving the public in a re-examination of the BLM plan for the area, would provoke adverse opinion toward mining public coal and toward Bureau planning efforts. Therefore, the attitudinal impacts of continued mining with or without lease modification will be adverse if the public is not involved in further review of the BLM plan prior to lease modification approval.

Reclamation

The impact of reclamation on public attitudes should be significant. Whether impact will be beneficial or adverse will depend on the success of the overall reclamation effort.

Local Regulatory Structure

There will be no impact on local regulatory structures under either alternative. The mine operation will not violate any existing rules and regulations. No changes in these rules and regulations as a result of mining is anticipated.

CHAPTER 4

MITIGATION

REQUIRED MEASURES

(Same as in Chapter 1)

1. Harmful overburden which could jeopardize reclamation shall be buried at a minimum depth of eight feet below the surface.
2. Soil material to be used in reclamation shall be removed and stockpiled, or placed directly on areas that have been mined and prepared for reclamation. Soil material which will be stockpiled for more than one year shall be seeded. Protective measures, such as orientation of stockpiles and reduced stockpile slopes, shall be taken to prevent soil loss to wind and water erosion.
3. Coal slack shall be buried in accordance with other toxic or harmful overburden (see 1 above).
4. All spoils must be graded to the approximate original land topography.
5. Following regrading, the Company, the surface owner, State Lands Department, and BLM representatives shall collectively determine areas to be reclaimed to native conditions and/or cultivation.
6. Seeding and planting composition, rates, and other revegetation criteria will also be determined following regrading.
7. Seeding will be done as instructed until it has been determined successful by BLM and State Lands Department.

8. Where an excavation is to be left as a permanent water impoundment, suitable accesses should be provided for people, wildlife and livestock.

9. Disposition of any final highwall shall be determined after consultation with the U. S. Geological Survey, BLM, State Lands Department, and the mining company.

10. To prevent or abate environmental pollution, any excessive amounts of pollutants will be prevented from reaching the air, water, or land resources, including surface water sources and ground water aquifers (Subsurface strata through which ground water moves). "Excessive amounts" of pollutants means any amount which exceeds the maximum amount permitted by the Federal Water Pollution Control Administration, National Air Pollution Control Administration, and by the appropriate agency of the State of Montana.

11. Haul roads shall be constructed to the minimum width necessary for efficient and safe operations. Haul roads must have adequate drainage and be constructed consistent with good watershed practices. Haul roads shall be sprinkled with water at time intervals necessary to reduce air pollution from dust. Haul roads shall be located so as not to interfere with proper shaping of spoilpiles. Haul roads may double as access roads.

12. Dams, ditches, dikes, and canals used for surface water control in and around the mining operation shall be constructed in accordance with approved engineering practices and located so as to do the least amount of environmental damage. Soil material shall be

placed on all dams and dikes following construction. These and all areas denuded during construction of water control structures shall be seeded after placement of soil material.

13. All drainage waters discharged into natural drainages must meet State and Federal water quality standards. Waters which enter the pit or overburden areas must meet State and Federal test requirements, prior to discharge into natural drainages. If necessary, they shall be impounded for chemical treatment and sediment disposal.

14. All operations shall be conducted so as to avoid range and forest fires and spontaneous combustion. Open burning of carbonaceous materials shall be in accordance with suitable practices for fire prevention and control. The mining company shall take immediate steps to extinguish any fires in piles of coal wastes or slack, or in an exposed face of in-place coal.

15. The active mining areas shall be posted, fenced, or otherwise protected where necessary to minimize injury to people, livestock, and wildlife.

16. Drill holes shall be temporarily protected at all times so as to prevent injury to people, livestock and wildlife. They shall be permanently sealed when the need for the drill hole no longer exists.

17. All existing improvements, including but not limited to gates, cattleguards, roads, trails, pipelines, bridges, public land survey monuments, and water development and control structures, shall be

replaced, restored, or appropriately compensated for as soon as practicable in the event they are damaged or destroyed by company operations.

18. Surface buildings, supporting facilities, haul roads, and other structures that have served their purpose shall be removed and the area shall be graded and revegetated.

19. Flowing springs, wells, and reservoirs which are eliminated by mining shall be replaced with wells drilled into deeper aquifers.

20. If an archaeological or historical site is discovered during mining, operations shall immediately cease and the BLM District Manager and other appropriate authorities shall be notified. A reasonable time will be allowed for evaluation or removal.

21. The lessee will be required to comply with all State laws and regulations concerning coal mining, including laws and regulations pertaining to the protection and reclamation of surface resources, and the protection of the land, air, and water environment, where applicable.

POSSIBLE ADDITIONAL MEASURES

The following additional measures were developed by the analysis team and could reduce the effects of mining the additional 320 acres of Area A.

By keeping all mining equipment properly maintained, the level of exhaust emissions would be reduced. Exhaust emission should be checked with each periodic maintenance of mining equipment.

Once topsoiling has been accomplished, any operation which would tend mix the topsoil with the regraded spoils should be avoided.

Revegetating with both shallow and deep rooted plant species could improve soil structure.

During mining, soil erosion and sediment load should be reduced by surface manipulation and installation of control devices such as settling ponds, water bars, check dams and culverts.

Upon replacement of topsoil, the second lift should be replaced first; then the first lift replaced over it. This would reduce the impact on soil structure and nutrients.

The use of fertilizers to establish an effective vegetative cover should follow guidelines established through soil testing. Quick establishment of a vegetative cover would reduce wind and water erosion and would improve soil nutrients and structure.

Surface manipulation of the regraded spoils prior to topsoiling would reduce the chance of topsoil slippage and improve infiltration rates.

By applying mulch to new seeding, a more favorable growth environment would be provided, evaporation rates would be reduced, and valuable organic matter would be supplied to the soil, thus providing for quicker revegetation and reducing both wind and water erosion.

Herbicides and pesticides should be used only when deemed absolutely necessary to assure reclamation success, and then only with extreme caution. This measure would help keep soil, water, and forage quality relatively free of pollutants.

Any geologic strata in the overburden which is found to have favorable soil-like properties should be stockpiled separately. This soil-like material could then be sandwiched between the reshaped spoil and the overlying topsoil. This would reduce the impacts on soil depth, soil structure, hydrologic cycle, and deep rooted terrestrial plant growth.

Surface manipulation of the topsoiled areas, by techniques such as gouging, dozer basins, and deep chiseling, could increase the infiltration, interception and retention capacity. This would also have beneficial effects on the hydrologic cycle, would reduce erosion, and would improve available moisture for vegetation.

Energy dispersion structures should be placed on water courses to reduce water velocity. This would reduce soil erosion and sediment load, and would mitigate the impacts on aquatic vegetation and animals.

Monitoring of water courses would assist in maintaining water quality in and around the mining site. This could reduce the impacts

from increased sediment load, dissolved oxygen, dissolved solids, nutrients, chemicals and heavy metals, and changes in pH and temperatures. In order to establish a base line of information, monitoring should be started prior to new mining and continue into the period following reclamation.

Controlling the amount of sediment entering water impoundments, would reduce the impacts on aquatic habitat.

Significant aquatic and riparian habitat, if encountered by the mining operation (i.e., Armells Creek - CFP-MF ELU) should be avoided when reasonably possible. In the reclamation process, all aquatic habitat lost to the mining operation should be replaced. However, it would also be desirable to create new wetland basins and seed them with aquatic plants. These actions would reduce the environmental impact of mining on an already small amount of aquatic plants and animals.

Diverse, native, terrestrial plant species (grasses, forbs, shrubs, and trees) should be replaced at the appropriate sites in the reclamation process as soon as suitable conditions exist. This measure should reduce the time the area is without vegetation.

In the revegetation process, various vegetation life forms should be planted in a manner, or pattern, that provides for maximum diversity and interspersion of ELU types. This procedure would help establish original vegetative aspect and diversity.

Reclamation plantings should be irrigated until vegetation establishment is assured. Irrigation should provide for a rapid growth rate and micro-climate moisture stability during the critical establishment period.

No grazing should be allowed on reclamation plantings until the vegetation is well established and can be expected to withstand grazing pressure. This measure should promote successful vegetation establishment.

On those areas to be grazed after reclamation is completed, carefully monitored management procedures should be instituted. This action would monitor permanent reclamation success through vegetation establishment.

In the regrading process, undulating terrain for animal cover should be developed. This would help provide some of the necessary ecological requirements of the endemic wildlife species.

Revegetation should be made similar to existing vegetation on unmined lands. Brush species should be planted adjacent to brush, and trees should be planted adjacent to trees, etc. This would reduce the contrast between mined and unmined areas.

During reclamation, trees and shrubs should be transplanted to areas where they presently exist. This would mitigate aesthetic impacts, in addition to providing food and cover for wildlife.

Native species should be used for revegetation. They would blend with vegetation on adjacent unmined areas and reduce aesthetic impacts.

The socio-economic impacts of coal development on Rosebud County should continue to be studied. Such monitoring may help mitigate future impacts in this region and in other areas. Data from the developments at Colstrip could be used to formulate mitigations in other areas, <u>before</u> the impacts occur.

Panel #1 of the Ellison Petroglyph should be removed and preserved in a museum. This action would mitigate the complete destruction of a

relatively unique resource. It may also promote positive public sentiment.

The Ellison Rock Site should be excavated by qualified archaeologists. This action would minimize the loss of remaining archaeological values at the site.

A minimum one mile buffer zone around the mining area should be surveyed to determine the presence of rock art sites. Any sites located should be evaluated and protected against possible deterioration due to nearby mining operations. This action would minimize the effect that blasting may have on cultural resources outside of the mining area.

New recreation facilities (campgrounds, picnic areas, etc.) should be developed on suitable sites near Colstrip. This would partially mitigate the impacts of increased recreation demands of increased populations created by the mining activity.

The boundary of the mined area should be "varied" or "feathered" during reclamation. This would reduce the strong contrast between mined and unmined areas and partially mitigate the impact on aesthetic values.

Permanent deep water ponds and contiguous recreation facilities could be developed during reclamation. Properly designed ponds would create fisheries and aquatic wildlife habitat. This would provide new habitat and diversify existing wildlife conditions. It would enhance recreation by providing new opportunities.

The mining company should keep local and county governments and the public informed about their operations. Cooperation among industry,

government, and the public in community planning efforts would help mitigate existing negative socio-economic and attitudinal impacts.

Governmental planning should be taking place on all levels to mitigate fiscal and social impacts of the future decline in mining operations. As the coal is depleted in the area, governmental agencies and the public should be prepared to deal with probable declines in jobs, population, and revenues.

Adverse impacts on attitudes and expectations would be mitigated if the BLM adjusted the coal lease modification to delete that portion in conflict with the South Rosebud Management Framework Plan. Deletion of this area would allow time to study the aesthetic, vegetative and erosion susceptibility conflicts and resolve them or to entertain the impacts in the regional EIS on the Colstrip area.

CHAPTER 5

RESIDUAL IMPACTS

If all recommended mitigating and enhancing measures from Chapter 4 are incorporated, some impacts could still result. Some of these residual impacts are those that would occur if the applied mitigating measures should fail.

CONTINUATION OF MINING WITHOUT LEASE MODIFICATION

(This alternative entails the continued mining of 2,000 acres of coal in Area A)

These residual impacts occur on the 2,000 acres and will continue, regardless of the decision made on the "proposed lease modivication":

1. There is an insignificant increase in exhaust emissions from mining equipment.
2. There is an increase in air temperatures close to the surface, until advanced vegetation, such as trees and shrubs are re-established in reclamation.
3. Fugitive dust levels are increasing from mining activities.
4. Air movement patterns close to the ground surface are changed until advanced vegetation, which currently influences the existing microclimate, is re-established.

5. Soil loss occurs during the topsoil removal and stockpiling stages of mining operations, and during the topsoil replacement stage of reclamation.

6. Soil depth is modified by removal and replacement of topsoil.

7. Soil structure is adversely affected by the soil disturbance during topsoil removal and replacement.

8. Soil disturbance breaks the closed nutrient cycle making nutrients more susceptible to leaching and erosion.

9. Mining the coal depletes a non-renewable mineral resource.

10. Some coal is lost during overburden removal, coal removal, loading, and transportation operations.

11. The integrity of the geologic structure is destroyed when the coal is removed.

12. Three topographic landforms (Mesa-butte tops, Mesa-butte steep side slopes, and massive sandstone bluffs) are permanently destroyed in the mined area.

13. By-passing the coal within the 320-acre tract would make Area A less efficient to mine and reclaim.

14. Land use compatibility with adjacent uses is being negatively affected for the period that the area is mined.

15. Ground water could potentially be deteriorated by chemicals in the spoils area and in areas recharged from the spoils.

16. Blasting of overburden and coal introduces foreign chemicals, such as nitrates, to the environment. The residual impact of this is unknown.

17. Sediment loads, water born nutrients, dissolved solids, pH, and toxic materials may be increased in surface and ground waters, because of increased permeability and porosity in regraded spoil and topsoil materials.

18. The hydrologic cycle is being changed. Increased surface runoff and infiltration occurs during site preparation and reclamation. In the mining stage, well #1 will lose its source of water. The resultant impacts caused by these changes are unknown.

19. It will take many years to achieve a vegetative complex similar to that existing prior to mining. This recovery period constitutes a residual impact. Woody tissue plants (trees and shrubs) will have a longer recovery period than grasses or forbs (steppe shrub, xerophytic forest, and mesophytic forest ELU's).

20. Any vegetative species that are removed during mining, and not replaced will be lost (i.e., lichens, mosses, etc.).

21. Displaced aquatic and terrestrial animals will not return to the mine area until their respective habitats are re-established.

22. Successional processes are set back during mining, and a climax successional stage will not be achieved until after a long recovery period. Depending on the emphasis of reclamation, this residual impact will have varying longevity.

23. Impacts on food and community relationships are expected to parallel those for #22 above.

24. The physical aspect of the land (ELU's) will not be replaced to its exact original form, quantity, or quality.

25. Cultural resources which were not located in the surveys, due to adverse ground conditions or subsurface location, will be lost.

26. Increased population may put new pressures on cultural resources throughout the region. Higher population exposes the resource to increased danger of destruction by relic collectors and vandals.

27. Known archaeological site remains will be destroyed.

28. Coal supplied to the upper Midwest will have a high positive residual socio-economic impact on Midwest Communities.

29. Existing socio-economic impacts on Rosebud County will continue.

30. If additional coal is not leased, people may feel that BLM caused the loss of a resource within an already existing mining operation.

31. Aesthetic values are significantly lowered during mining because of surface disturbance, noise, dust, etc.

32. Existing scenery will be permanently lowered from Class B to Class C.

33. Increased outdoor recreation demands will add to existing unmet demands.

CONTINUATION OF MINING WITH LEASE MODIFICATION

(The "proposed action" is the proposal for mining an additional 320 acres of coal within Area A)

Most of the residual impacts for the "proposed action" are the same as those for the "alternative" which will occur regardless of the decision made on the "proposed action". The following residual impacts are those that would be in addition to the "alternative" residual impacts.

1. The mine would be developed in a more efficient and less costly nature. Both the mining and reclamation plans would be more practical, and the loss of the additional coal would be avoided. This would have a positive impact on those people who feel the additional coal should not be bypassed.
2. If the proposed modified coal lease application is not adjusted to exclude the 120 acres identified to have the conflicting aesthetic, vegetative, and soil values, portions of several important ELU's containing these values would be destroyed. This would also adversely affect peoples' attitudes and expectations.

CHAPTER 6

SHORT-TERM USE VS. LONG-TERM PRODUCTIVITY

CONTINUATION OF MINING WITHOUT LEASE MODIFICATION

(This alternative entails the continued mining of 2,000 acres of coal in Area A)

The short-term in this action is that period during which the substantive part of the action takes place. The long-term is that period during which subsequent effects of the action will continue to impact the environment, for the next twenty years. The short-term would be the life span of the mine, and the long-term would be time beyond the operating life of the mine.

The short-term use of the environment is mining for the purpose of providing energy for an area of the upper Midwest. The amount of ranch land available during the mining operation will be reduced by about 600 acres in any year (1 year to strip soil ahead of the mining, 1 year of mining, 1 year of reclamation, and 2 years to establish grass, which totals 5 years at 120 acres per year).

In the long term the trade-off between the mining and ranching will be eliminated if reclamation is successful. In fact the reclaimed area may be even more suitable for ranching. This could then be a long-term beneficial impact.

It is difficult to forecast a benefit for wildlife unless the reclamation process is aimed at improving wildlife habitat. The primary

direction of reclamation is toward agriculture. Long-term impacts will be a reduced abundance of wildlife because of less or different habitat. This long-term change will include a changed topography, a changed runoff pattern for surface water, and changed local air movement patterns.

Aesthetics and land use compatibility will be sacrificed in order to produce the needed energy; however, this will be short-term unless reclamation is not entirely successful. Assuming successful reclamation, aimed at a diversity of use and given adequate time, the potential productivity capacity of the site will be re-established.

The choice to not lease will probably foreclose a later choice to use the coal resource.

CONTINUATION OF MINING WITH LEASE MODIFICATION

(This is the proposal for mining an additional 320 acres of coal within Area A)

If the lease modification is approved, the additional coal would be mined concurrently with the surrounding coal and be used in the short-term. It would not be lost as a resource.

The other relationships discussed under the "continuation of mining without lease modification" alternative are also applicable to the "continuation of mining with lease modification." No additional relationships of long-term impacts to the short-term use were identified.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

CONTINUATION OF MINING WITHOUT LEASE MODIFICATION

(This entails the continued

mining of 2,000 acres of coal in Area A)

Denial of the lease modification would commit the additional coal in the 320-acre "proposed lease modification" area to non-use.

CONTINUATION OF MINING WITH LEASE MODIFICATION

(This is the proposal for mining an additional 320 acres of coal within Area A)

Allowing the lease modification would commit the coal resource to be utilized. This could materially benefit the consuming public and Western Energy Company, and the government could benefit from rental and royalty payments.

The "continuation of mining with lease modification" would permit the extraction and use of the resource to provide material and economic benefits. The "continuation of mining without lease modification" would, for all practical purposes, commit the resource to non-use. Both the options are therefore irreversible and irretrievable commitments of the coal resource.

CHAPTER 8

INTENSITY OF PUBLIC INTEREST

In order to determine the level of public interest, and to solicit information on the proposed action, the Miles City BLM District Office sent a letter and questionaire to potentially concerned persons, groups, and agencies informing them of the action. Seventy-eight copies of the letter were sent and thirty-two questionaires were returned, constituting a response rate of 41%. Of those responding, most asked for a copy of the document and indicated that they would respond to it. This is an expression of relatively high interest by those receiving the letter.

Of those that responded, most responses expressed interest in legal and administrative topics. The second most common response expressed an interest in water quality and use. (See Appendix 4).

In general, interest is high in almost any activity taking place in the Colstrip area. Regardless of the outcome of the lease modification proposal, the decision maker can expect to receive expressions of interest and concern from those who feel their positions were not advocated.

CHAPTER 9

CONSULTATION AND PARTICIPATING STAFF

RECORD OF PERSONS, GROUPS, AND GOVERNMENT AGENCIES CONSULTED

Most of the non-BLM input during the preparation of this analysis was in the form of source information used in Chapter 2. Western Energy Company provided the background information for the assimilation of Chapter 1. The following persons and agencies were contacted or consulted during the preparation of this environmental analysis record.

1. Lynn B. Fredlund - Research Archaeologist, Montana College of Mineral Science and Technology, Mineral Research Center, Butte, MT.
2. Wes Burnett - Recreation and Parks Division Montana Department of Fish and Game, Helena, MT.
3. Dave C. Conklin - Recreation and Parks Division, Montana Department of Fish and Game, Helena, MT.
4. Stuart Conner - Amateur Archaeologist, Billings, MT.
5. Mike Grende - Western Energy Company, Butte, MT.
6. Bill Schwarzkoph - Ecological Consulting Service, Helena, MT.
7. Chad Martin - Ecological Consulting Service, Helena, MT.
8. Bob Carroll - Ecological Consulting Service, Helena, MT.
9. Tom Smith - Montana Power Company, Butte, MT.
10. Montana State Employment Service - Miles City, MT.
11. U.S.D.A., Soil Conservation Service - Forsyth, MT.
12. Jim Bishop - Burlington Northern, Miles City, MT.

PARTICIPATING STAFF

The following persons on the Bureau of Land Management staff participated in the preparation of this Environmental Analysis Record:

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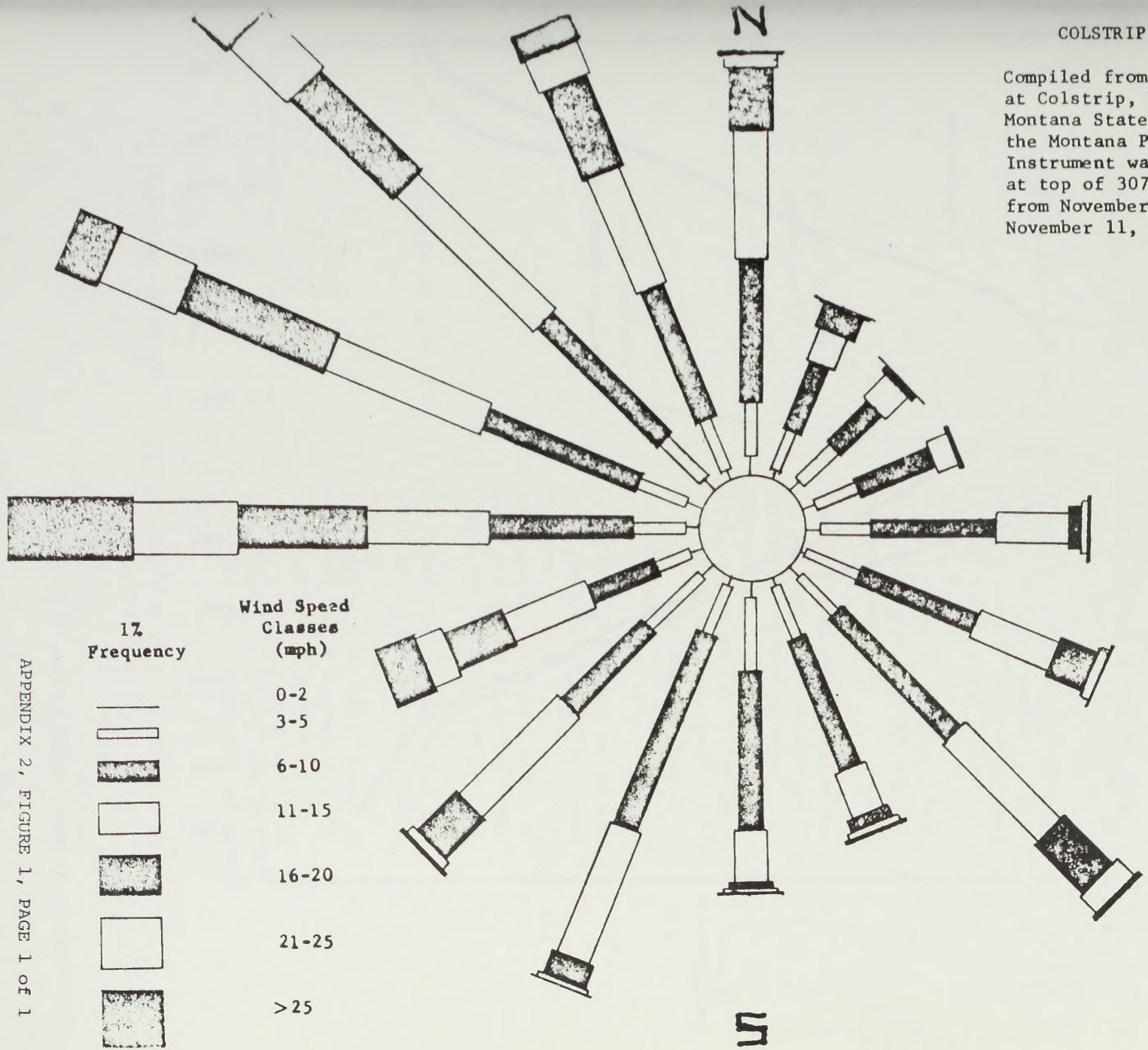
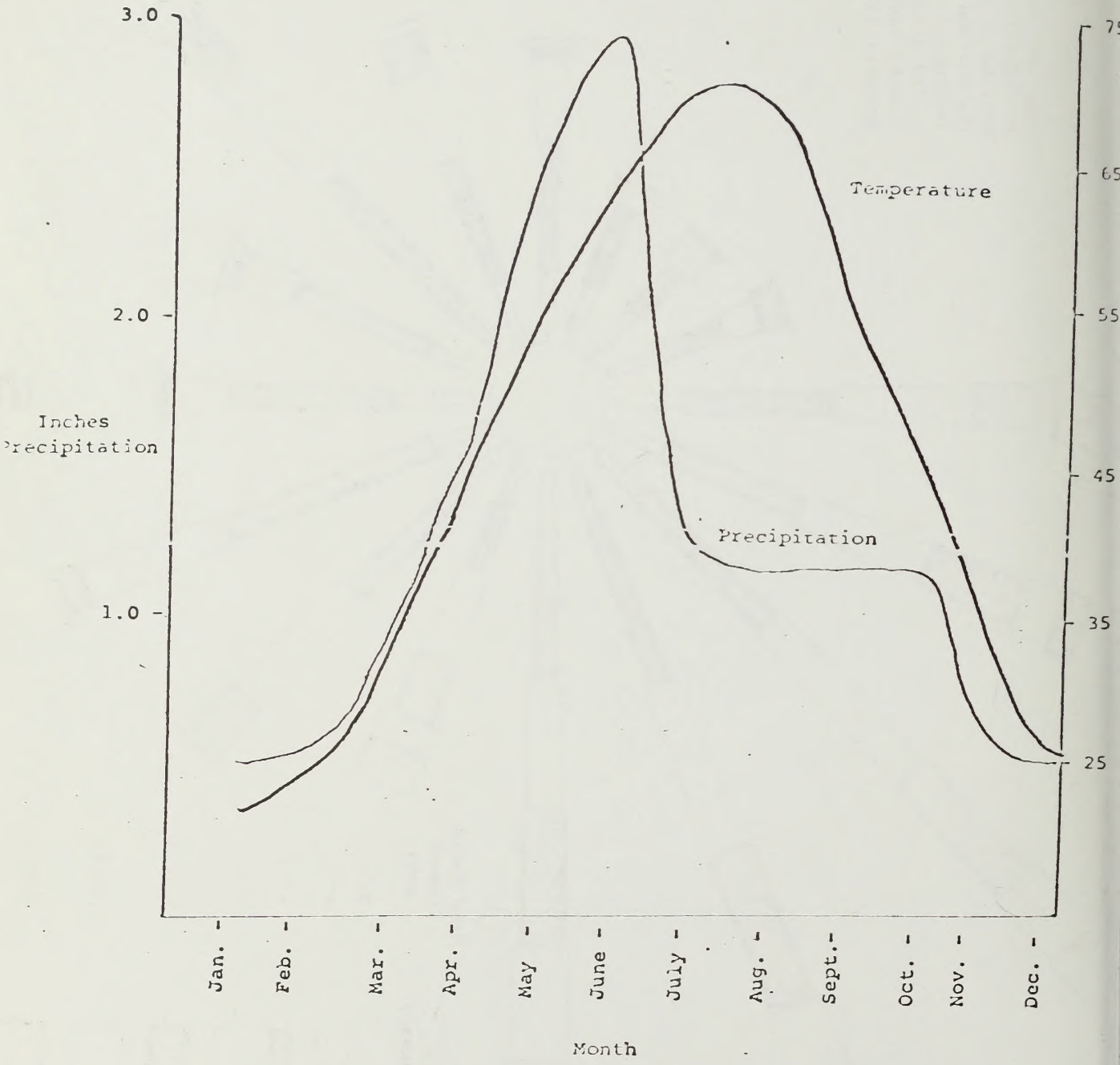
APPENDIX 2

COLSTRIP WIND ROSE

Compiled from wind data taken at Colstrip, Montana by Montana State University for the Montana Power Company. Instrument was in operation at top of 307 foot tower from November 12, 1971 - November 11, 1972.



Monthly distribution of Precipitation and Temperature
Colstrip, Montana.
(30 years of Record)



APPENDIX 2, FIGURE 2, PAGE 1 of 1

16-2.14(1)-S14040 AMBIENT AIR QUALITY STANDARDS

(1) In accordance with Section 69-3909, subsection 12 of the Clean Air Act of Montana, on May 7, 1967, the board adopted the Ambient Air Quality Standards shown below.

(2) Until additional pertinent information becomes available with respect to the effects of the substances listed below, the following air quality criteria shall apply in Montana.

Pollutants	Standards (Maximum permissible concentrations)
Sulfur dioxide[a]	0.02 ppm, maximum annual average 0.10 ppm, 24-hour average, not to be exceeded over 1 percent of the days in any 3-month period 0.25 ppm not to be exceeded for more than one hour in any 4 consecutive days.
Reactive sulfur (sulfation[b])	0.25 milligrams sulfur trioxide per 100 square centimeters per day, maximum annual average 0.50 milligram sulfur trioxide per 100 square centimeters per day, maximum for any 1-month period
Suspended sulfate[c]	4 micrograms per cubic meter of air, maximum allowable annual average 12 micrograms per cubic meter of air, not to be exceeded over 1 percent of the time
Sulfuric acid mist[d]	4 micrograms per cubic meter of air, maximum allowable annual average 12 micrograms per cubic meter of air, not to be exceeded over 1 percent of the time 30 micrograms per cubic meter of air, hourly average, not to be exceeded over 1 percent of the time
Hydrogen sulfide[e]	0.03 ppm, ½-hour average, not to be exceeded more than twice in any 5 consecutive days 0.05 ppm, ½-hour average, not to be exceeded over twice a year

Pollutants	Standards (Maximum permissible concentrations)
Total suspended particulate[f]	75 micrograms per cubic meter of air, annual geometric mean 200 micrograms per cubic meter of air, not to be exceeded more than 1 percent of days a year
Settled particulate (Dustfall[g])	15 tons per square mile per month, 3-month average in residential areas 30 tons per square mile per month, 3-month average in heavy industrial areas
Lead[h]	5.0 micrograms per cubic meter of air, 30-day average
Beryllium[i]	0.01 micrograms per cubic meter of air, 30-day average
Fluorides, total (as HF) in air[j]	1 part per billion parts of air, 24-hour average
Fluorides (as F) in forage[k] for animal consumption - dry weight basis	35 parts per million
Fluorides (gaseous)[l]	0.3 micrograms per square centimeter per 28 days

a. Sulfur dioxide measured by West-Gaeke or conductometric method.

b. Sulfation measured by lead-peroxide candle.

c. Suspended sulfate measured by high volume sampler - turbidmetric procedure.

d. Sulfuric acid mist - Air Pollution Control District, County of Los Angeles, APCD - Sulfuric acid 13-49.

e. Hydrogen sulfide measured by methylene blue method - acetate tape for screening and monitoring.

f. Suspended particulate measured by high-volume sampler.

g. Dustfall measured by container open to atmosphere.

h. Suspended lead measured by high-volume sampler - dithizone and/or spectrophotometric procedures.

i. Suspended beryllium measured by high-volume sampler - fluorometric and/or spectrophotometric method.

j. Total fluoride measured by impingers - Winter-Willard distillation procedure (SPADNS color).

k. Forage cut, dried, ashed and subjected to Winter-Willard distillation procedure (SPADNS color).

l. Gaseous fluorides measured by calcium formate paper technique in board standard shelter - Winter-Willard distillation procedure (SPADNS color).

The ambient air quality standards listed describe a level of air quality designed to protect people from the adverse effects of air pollution; and they are intended further to promote maximum comfort and enjoyment in use of property consistent with economic and social well-being of the community.

Ambient air quality standards are used as a tool in achieving cleaner air, not as a license to permit unnecessary degradation of air quality which would thwart attainment of the long-range goal to maintain a reasonable degree of air purity.

These standards are not intended to represent the ultimate in air quality achievement. It is anticipated that research and development will gradually make possible cleaner air at lower cost. As evidence accumulates on deleterious effect of the contaminant, present objectives will be revised or additional standards established. The standards are designed to protect the health, welfare and comfort of the public and to minimize economic losses.

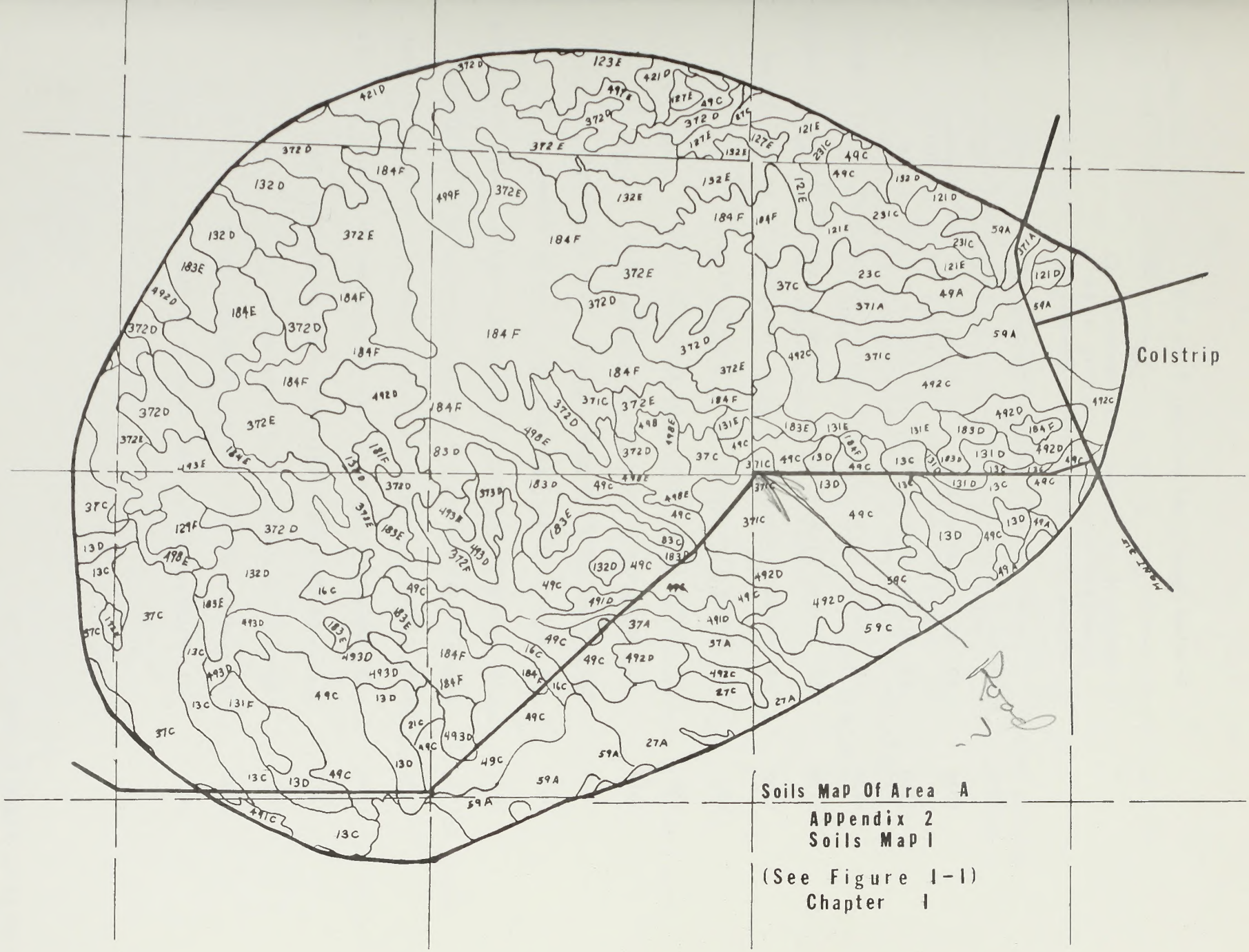
Because some pollutants combine chemically to form more harmful materials than the original emissions, ascribing a single effect to a single pollutant would be an erroneous over-simplification. The standards, therefore, apply to air containing a variety of pollutants. Although reaching the goals will result in benefits, no allowance for the time needed to achieve them was considered in their selection. They are intended to apply to areas where people live or where an adverse effect may occur.

The board, in adopting these standards, intends them to be goals and guidelines and so interprets the legislative intent of the word "standards" in Section 69-3909 of the Clean Air Act of Montana.

(3) The sampling and analytical procedures employed to measure ambient levels of contaminants are to be consistent with obtaining accurate results which are representative of the conditions being evaluated. The sampling and analytical techniques enumerated may be used directly or employed as reference standards against which other methods may be calibrated.

SERIES CLASSIFICATION

Birney	Borollic Camborthids, loamy-skeletal, mixed
Boxwell, deep variant	Aridic Haploborolis, fine-loamy, mixed
Busby	Borollic Camborthids, coarse-loamy, mixed
Cabbart	Ustic Torriorthents, loamy, mixed (calcareous), frigid, shallow
Chinook	Aridic Haploborolls, coarse-loamy, mixed
Colstrip	Ustic Torriorthents, loamy-skeletal, mixed (calcareous), frigid
Cooers	Borollic Camborthids, fine-loamy, mixed
Floweree	Aridic Haploborolls, fine-silty, mixed
Kirby	Ustic Torriorthents, fragmental, mixed, frigid
Kobar	Borollic Camborthids, fine, montmorillonitic
Lambeth	Ustic Torriorthents, fine-silty, mixed (calcareous), frigid
Lonna	Borollic Camborthids, fine-silty, mixed
Rentsac	Lithic Ustic Torriorthents, loamy-skeletal, mixed (calcareous), frigid
Spang	Borollic Camborthids, coarse-loamy, mixed
Yamac	Borollic Camborthids, fine-loamy, mixed
Yawdim	Ustic Torriorthents, clayey, mixed (calcareous), frigid, shallow
Zeona	Ustic Torripsamments, mixed, frigid


Colstrip
Soils Map Of Area A
Appendix 2
Soils Map I
(See Figure I-I)
Chapter I

Rosebud County Soil Survey Area 649

Identification Legend

Numerical Listing Of Mapping Units
March, 1975

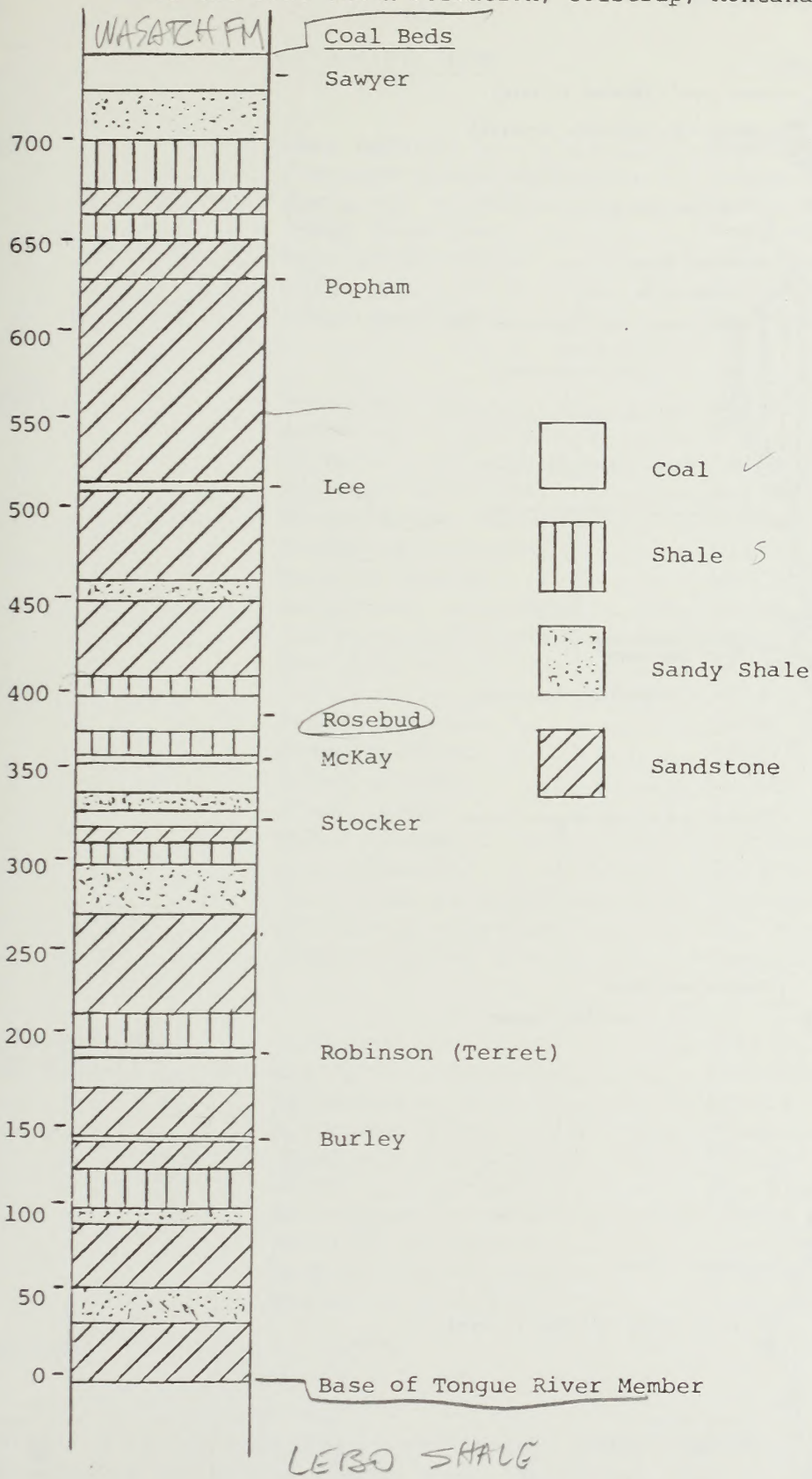
MAPPING UNIT SYMBOL	ACRES	MAPPING UNIT NAME
121E	49	Birney-Kirby-Cooers complex, 15 to 25% slopes
122D	44	Birney-Cooers-Kirby complex, 2 to 15% slopes
123E	46	Birney-Kirby channery loams, forested 15 to 25% slopes
127E	18	Birney-Kirby-Cabbart complex, forested, 15 to 25% slopes
129F	24	Colstrip-Cabbart complex, forested, 25 to 70% slopes
13C	106	Busby fine sandy loam, 2 to 8% slopes
13D	107	Busby fine sandy loam, 8 to 15% slopes
131E	65	Busby-Zeona complex, 8 to 25% slopes
132E	193	Busby-Cabbart-Zeona complex, 8 to 25% slopes
16C	24	Boxwell loam, deep variant, 2 to 8% slopes
181F	8	Cabbart-Colstrip-Rock outcrop complex, 25 to 70% slopes
183E	141	Cabbart-Busby-Rock outcrop complex, 8 to 25% slopes
184F	540	Cabbart-Yawdim-Rock outcrop complex, 15 to 70% slopes
185E	13	Cabbart-Busby-Rock outcrop complex, forested, 8 to 25% slo
21C	7	Chinook fine sandy loam, 2 to 8% slopes
23C	21	Cooers loam, 2 to 8% slopes
231C	20	Cooers-Birney complex, 2 to 8% slopes
27A	67	Floweree silt loam, 0 th 2% slopes

MAPPING UNIT SYMBOL	ACRES	MAPPING UNIT NAME
27C	11	Floweree silt loam, 2 to 8% slopes
36C	4	Lambeth silt loam, 2 to 8% slopes
37A	28	Lonna silt loam, 0 to 2% slopes
37C	172	Lonna silt loam, 2 to 8% slopes
37D	108	Lonna silt loam, 8 to 15% slopes
372E	616	Lonna-Cabbart-Yawdim complex, 8 to 25% slopes
421D	10	Spang-Cooers-Birney complex, 8 to 15% slopes
49A	40	Yamac loam, 0 to 2% slopes
49C	396	Yamac loam, 2 to 8% slopes
49D	26	Yamac loam, 8 to 15% slopes
491C	65	Borollic Camborthids-Ustic Torrifluvents, 2 to 8% slopes
492C	89	Yamac-Busby complex, 2 to 8% slopes
492D	147	Yamac-Busby complex, 8 to 15% slopes
493D	48	Yamac-Rentsac complex, 2 to 15% slopes
493E	10	Yamac-Cabbart complex, 15 to 25% slopes
497F	60	Yamac-Yawdim-Cabbart complex, forested, 25 to 70% slopes
498E	72	Yamac-Yawdim-Cabbart complex, 8 to 25% slopes
499F	31	Cabbart-Colstrip-Yamac complex, forested, 25 to 70% slopes
59A	196	Kobar silty clay loam, 0 t0 2% slopes
59C	147	Kobar silty clay loam, 2 to 8% slopes
	3,769	Acreage Total

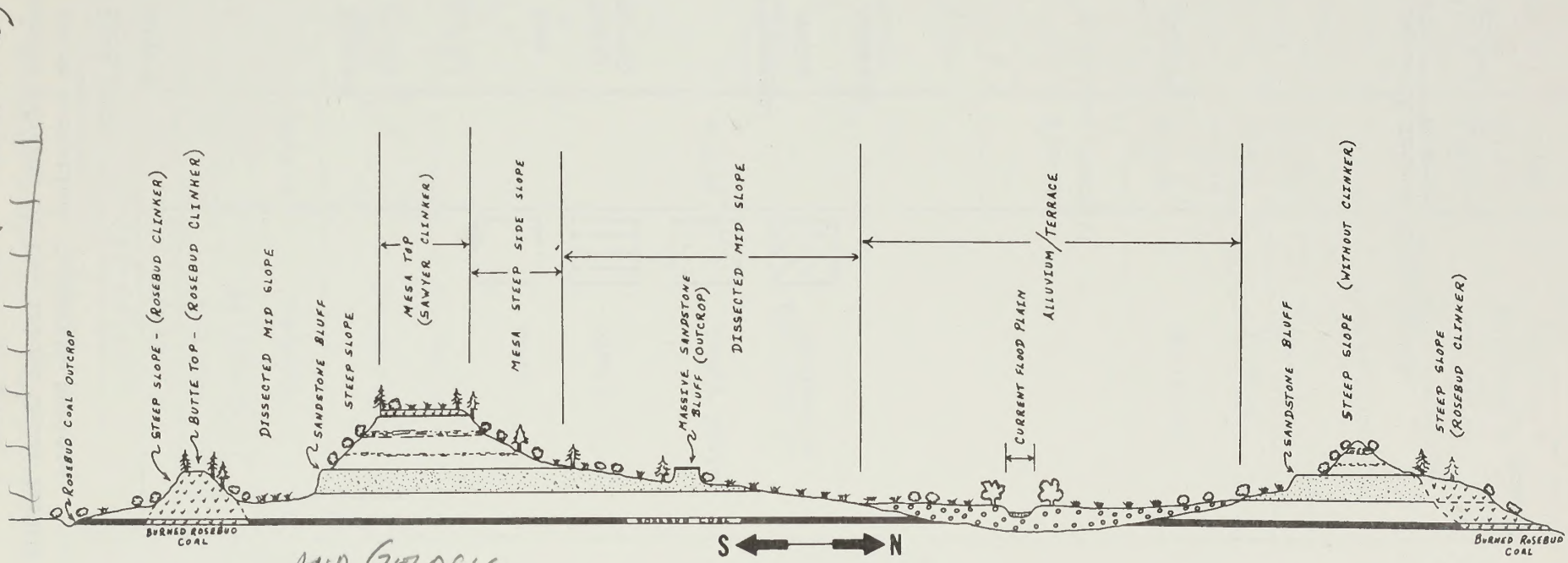
Stratigraphic Chart - Tongue River Basin
(After: Wyoming Geological Association Guidebook - 1958 - p. 20)

ERA	PERIOD			MONTANA	
CENOZOIC	QUATERNARY			ALLUVIUM AND TERRACE GRAVELS	
	TERTIARY	PLIOCENE		FLAXVILLE GRAVEL	
		MIOCENE		ARIKAREE	
		OLIGOCENE		WHITE RIVER	
		EOCENE	LOWER	WASATCH	
		PALEOCENE		FORT UNION	TONGUE RIVER
					LEBO SHALE
					TULLOCK
MESOZOIC	CRETACEOUS		UPPER	LANCE	HELL CREEK
				MONT. GROUP	FOX HILLS (LENNEP?)
					BEARPAW SHALE
					JUDITH RIVER
					PARKMAN MEM.
					CLAGGETT
					EAGLE SS.
					TELEGRAPH CR.
					NIOBRARA
					CARLILE SH.
				COLO. GROUP	FRONTIER
					MOWRY SH.
				?	MUDDY (BIRDHEAD) SS.
				?	THERMOPOLIS SH.
			LOWER	KOOTENAI FM.	
	JURASSIC		UPPER	MORRISON FM.	
				ELLIS FM.	
			MIDDLE	PIPER FM.	
	TRIASSIC		LOWER	SPEARFISH	
PALEOZOIC	PERMIAN		UPPER	EMBAR	
	PENNSYLVANIAN			TENSLEEP	
				AMSDEN FM.	
	MISSISSIPPIAN		LOWER	MADISON	CHAS. MEM.
	DEVONIAN		UPPER	JEFFERSON	
	ORDOVICIAN		UPPER	BIG HORN	
	CAMBRIAN		UPPER	DEADWOOD	
PRECAMBRIAN				GRANITE-GNEISS-SCHIST	

Generalized Stratigraphic Section of the Tongue River Member of the Fort Union Formation, Colstrip, Montana



Scale: 1" = 100'



PHYSIOGRAPHIC AND GEOLOGIC CROSS SECTION - Where? Line on which map? Where is MINVÉ?

Land Form Units and Vegetative Life Forms

COLSTRIP, MONTANA

APPENDIX 2 FIGURE 5

MILES (Kilos)

Legend

- Steppe Grassland Region — SS
- Steppe Shrub Region — ?
- Xerophytic Forest Region — ?
- Mesophytic Forest Region — Coal
- Clinker

PARTIAL PLANT LIST IN THE VICINITY OF COLSTRIP*

	Scientific Name	Common Name
TREES:	*Acer negundo*	Boxelder
	Fraxinus pennsylvanica	Green ash
	Juniperus scopulorum	Rocky Mountain juniper
	Pinus ponderosa	Ponderosa pine
	Populus deltoides	Plains cottonwood
	Salix spp	Willow
	Ulmus americana	American elm
SHRUBS:	*Artemisia cana*	Silver sagebrush
	Artemisia tridentata	Big sagebrush
	Atriplex confertifolia	Shadscale saltbush
	Atriplex nuttallii	Nuttall saltbush
	Chrysothamnus nauseosus	Rubber rabbitbrush
	Crataegus succulenta	Fleshy hawthorn
	Eurotia lanata	Winterfat
	Gutierrezia sarothrae	Broom snakeweed
	Juniperus horizontalis	Creeping juniper
	Oenothera serrulata	Shrubby evening primrose
	Prunus americana	Wild plum
	Prunus virgiana	Chokecherry
	Rhus trilobata	Skunkbush sumac
	Ribes aureum	Golden currant
	Ribes cereum	Squaw currant
	Ribes setosum	Redshoot gooseberry
	Rosa arkansana	Prairie rose
	Sarcobatus vermiculatus	Greasewood
	Shepherdia argentea	Buffalo-berry
	Symphoricarpos spp	Snowberry
GRASSES AND GRASS-LIKE PLANTS:	*Agropyron cristatum*	Crested wheatgrass
	Agropyron intermedium	Intermediate wheatgrass
	Agropyron smithii	Western wheatgrass
	Agropyron spicatum	Bluebunch wheatgrass
	Agropyron trachycaulum	Slender wheatgrass
	Andropogon gerardi	Big bluestem
	Andropogon scoparius	Little bluestem
	Aristida longiseta	Red three-awn
	Bouteloua curtipendula	Side-oats grama
	Bouteloua gracilis	Blue grama

(Continued)

*This list is not complete at this time. Plant specimens were identified in the field with the aid of floral keys. Specimens have not been verified by comparison with an herbarium collection.

	Scientific Name	Common Name
GRASSES AND GRASS-LIKE PLANTS (Continued)	*Bromus inermis*	Smooth brome
	Bromus japonicus	Japanese chess
	Bromus tectorum	Downy chess brome
	Calamovilfa longifolia	Prairie sand reedgrass
	Carex spp	Sedge
	Carex filifolia	Threadleaf sedge
	Carex viridula	Green sedge
	Distichlis stricta	Inland saltgrass
	Elymus canadensis	Canada wild-rye
	Festuca idahoensis	Idaho fescue
	Hordeum jubatum	Foxtail barley
	Koeleria cristata	Junegrass
	Muhlenbergia cuspidata	Plains muhly
	Oryzopsis hymenoides	Indian ricegrass
	Oryzpsis micrantha	Littleseed ricegrass
	Panicum capillare	Witchgrass
	Panicum virgatum	Switchgrass
	Phalaris arundinacea	Reed canary grass
	Poa ampla	Big bluegrass
	Poa canbyi	Canby bluegrass
	Poa pratensis	Kentucky bluegrass
	Poa scabrella	Pine bluegrass
	Poa secunda	Sandberg bluegrass
	Poa spp	Bluegrass
	Scirpus spp	Rush
	Spartina gracilis	Alkali cordgrass
	Sporobolus airoides	Alkali dropseed
	Stipa comata	Needle-and-thread
	Stipa viridula	Green needlegrass
	Typha latifolia	Common cattail
	Vulpia octoflora	Sixweeksgrass
FORBS:	*Achillea millefolium*	Yarrow
	Alisum plantago-aquatica	American water-plantain
	Allium textile	Wild onion
	Alyssum alssoides	Pale alyssum
	Amaranthus albus	White pigweed
	Amaranthus retroflexus	Redroot pigweed
	Ambrosia artemisifolia	Low ragweed
	Androsace septentrionalis	Northern androsace
	Antennaria parvifolia	Small-leaf pussytoes
	Antennaria rosea	Rose pussytoes
	Arenaria hookeri	Hooker sandwort
	Argemone intermedia	Prickly poppy
	Artemisia biennis	Biennial sagewort

(Continued)

	Scientific Name	Common Name
FORBS: (Continued)	*Artemisia dracunculus*.....	False-tarragon sagewort
	Artemisia frigida.....	Fringed sagewort
	Artemisia ludoviciana.....	Cudweed sagewort
	Asclepias speciosa.....	Showy milkweed
	Asclepias verticillata.....	.....
	Asclepias viridiflora.....	Green milkweed
	Aster canescens.....	Hoary aster
	Aster spp.....	Aster
	Astragalus canadensis.....	Canada milkvetch
	Astragalus cicer.....	Cicer milkvetch
	Astragalus dasyglottis.....	Purple milkvetch
	Astragalus gilviflorus.....	Three-leaved milkvetch
	Astragalus gracilis.....	.....
	Astragalus missouriensis.....	Missouri milkvetch
	Astragalus purshii.....	Pursh loco
	Astragalus striatus.....	Prairie milkvetch
	Bahia oppositifolia.....	Opposite-leaf bahia
	Balsamorhiza sagittata.....	Arrowleaf balsamroot
	Besseya wyomingensis.....	Kittentail
	Calochortus nuttallii.....	Mariposa lily
	Camelina microcarpa.....	Littlepod false-flax
	Campanula rotundifolia.....	Roundleaf harebell
	Capsella bursa-pastoris.....	Shepherd's purse
	Carduus nutans.....	Musk thistle
	Castilleja sessiliflora.....	Indian paintbrush
	Cerastium arvense.....	Field chickweed
	Chaenactis douglasii.....	Douglas dusty maiden
	Chenopodium album.....	Lamb's quarter
	Chenopodium leptophyllum.....	Narrowleaf goosefoot
	Chorispora tenella.....	.....
	Chrysopsis villosa.....	Golden-aster
	Cirsium undulatum.....	Wavyleaf thistle
	Comandra umbellata.....	Pale bastard toadflax
	Convolvulus arvensis.....	Field bindweed
	Crepis spp.....	Hawksbeard
	Cryptantha bradburiana.....	Miner's candle
	Delphinium bicolor.....	Low larkspur
	Draba nemorosa.....	Woods draba
	Echinacea pallida.....	Purple coneflower
	Erigeron divergens.....	Spreading fleabane
	Erigeron pumilus.....	.....
	Eriogonum annum.....	Annual eriogonum
	Eriogonum multiceps.....	.....
	Erodium cicutarium.....	Alfilaria
	Erysimum asperum.....	Plains wallflower
	Euphorbia robusta.....	Robust spurge

(Continued)

	Scientific Name	Common Name
FORBS: (Continued)	*Evolvulus nuttallianus*	.....
	Fritillaria pudica	Yellow bell
	Gaura coccinea	Scarlet gaura
	Gaura parviflora	Small-flowered gaura
	Geum triflorum	Prairie smoke
	Gilia congesta	Densely flowered gilia
	Glycyrrhiza lepidota	Wild licorice
	Grindelia squarrosa	Curlcap gumweed
	Hackelia floribunda	Many flowered stickseed
	Haplopappus lanceolatus	Lance goldenweed
	Haplopappus nuttalii	Nuttall goldenweed
	Haplopappus spinulosus	Spiny goldenweed
	Hedeoma drummondii	Drummond false pennyroyal
	Helianthus annuus	Common sunflower
	Helianthus petiolaris	Prairie sunflower
	Hesperis matronalis	Rocket
	Hymenopappus filifolius	Narrowleaf hymenopappus
	Kochia scoparia	Kochia, summer cypress
	Lactuca pulchella	Blue lettuce
	Lactuca serriola	.....
	Lappula echniata	Eupopean stick tight
	Lappula redowskii	Western stick tight
	Lepidium densiflorum	Prairie pepperweed
	Lepidium perfoliatum	Clasping pepperweed
	Lesquerella ludoviciana	Silver bladderpod
	Leucocrinum montanum	Mountain star lily
	Liatris punctata	Dotted blazingstar
	Linum perenne	Blue flax
	Linum rigidum	Stiffstem flax
	Lithospermum arvense	Field gromwell
	Lithospermum incisum	Narrowleaf gromwell
	Lomatium spp	.....
	Lupinus lepidus	Pacific lupine
	Lygodesmia juncea	Rush skeleton weed
	Mamillaria vivipara	Pink pincushion cactus
	Marrubium vulgare	Horehound
	Medicago lupulina	Black medic
	Medicago sativa	Alfalfa
	Melilotus alba	White sweetclover
	Melilotus officinalis	Yellow sweetclover
	Mentha arvensis	Field mint
	Mentzelia decapetala	Ten-petal blazing star
	Mertensia lanceolata	Lanceleaf bluebell
	Microseris cuspidata	.....
	Monarda fistulosa	Horse mint
	Oenothera biennis	Rydberg's evening primrose

(Continued)

	Scientific Name	Common Name
FORBS: (Continued)	*Oenothera caespitosa*.....	Tufted evening primrose
	Oenothera nuttallii.....	Nuttall evening primrose
	Opuntia polycantha.....	Plains prickleypear
	Oxytropis lambertii.....	Purple pointloco
	Oxytropis sericea.....	White pointloco
	Pedicularis paysoniana.....	.....
	Penstemon albidus.....	White penstemon
	Penstemon eriantherus.....	Fuzzytongue penstemon
	Penstemon nitidus.....	Waxleaf penstemon
	Petalostemon candidum.....	White prairie-clover
	Petalostemon purpureum.....	Purple prairie-clover
	Phacelia franklinii.....	.....
	Phacelia hastata.....	Silverleaf phacelia
	Phlox hoodii.....	Hoods phlox
	Phlox kelseyi.....	Kelsey phlox
	Physaria didymocarpa.....	Common twinpod
	Plantago purshii.....	Woolly plantain
	Potentilla gracilis.....	Northwest cinquefoil
	Psoralea argophylla.....	Silverleaf scurfpea
	Psoralea esculenta.....	Breadroot scurfpea
	Psoralea tenuiflora.....	Slimflower scurfpea
	Ranunculus glaberrimus.....	Sagebrush buttercup
	Ratibida columnifera.....	Prairie coneflower
	Rhus radicans.....	Poison ivy
	Rumex crispus.....	Curl dock
	Sagittaria cuneata.....	Arum-leaved arrowleaf
	Salsola kali.....	Russian thistle
	Senecio canus.....	Woolly groundsel
	Senecio integerrimus.....	Lambs-tongue groundsel
	Sisymbrium altissimum.....	Tumblemustard
	Sisymbrium loeselii.....	Smallpod tumblemustard
	Smilacina stellata.....	Starry false Solomon's seal
	Solidago canadensis.....	Canada goldenrod
	Solidago missouriensis.....	.....
	Solidago mollis.....	Goldenrod
	Sphaeralcea coccinea.....	Scarlet globemallow
	Taraxacum officinale.....	Common dandelion
	Thermopsis rhombifolia.....	Prairie thermopsis
	Thlaspi arvense.....	Fanweed
	Townsendia hookeri.....	.....
	Tradescantia occidentalis.....	Spiderwort
	Tragopogon dubius.....	Common salsify
	Urtica dioica.....	Stinging nettle
	Verbascum thapsus.....	Flannel mullein
	Verbena bracteata.....	Bracted verbena
	Vicia americana.....	American vetch

(Continued)

	Scientific Name	Common Name
FORBS: (Continued)	*Viola nuttallii*.....	Nuttall violet
	Yucca glauca.....	Soap-weed
	Zigadenus venenosus.....	Meadow death camas

Adapted from "Four Seasons Wildlife Report - Peabody Coal Company Big Sky Mine, Area A - Project 58-23-A" by Ecological Consulting Service, dated October 1, 1974.

PRINCIPLE GRASS SPECIES OF THE STEPPE GRASSLAND REGION

Cool Season Grasses -

Needle grasses

Wheatgrasses

Wild rye

Blue grasses

Thread leaf and

Needle leaf sedges

June grass

Warm Season Grasses -

Grama grasses

Buffalo grass

Three Awn

Big and little blue stem

Dropseed

Switch grass

(Also see Appendix 2, Table 4 for scientific names)

DEER PELLET GROUP FREQUENCIES IN
DIFFERENT HABITAT TYPES, COLSTRIP, SUMMER, 1974*

	Plant Community 1/	Transect Length (Ft) 2/	Pellet Group Frequency	Notes
1.	Ponderosa - sumac	4,680	0.74/100'	
2.	Ponderosa - sumac	2,600	0.96/100'	
3.	Ponderosa - sumac	1,560	0.38/100'	
		8,840	0.73 3/	(59%)
4.	Cheatgrass - fringed sage	4,420	0.06/100'	
5.	Cheatgrass - western wheatgrass	3,900	0.02/100'	600'-900' from ponderosa series
6.	Bluegrass - silver sage	1,300	0.08/100'	300'-600' from ponderosa series
7.	Bluegrass - silver sage	2,080	0.2/100'	
		11,700	0.07 3/	(6%)
8.	Blue bunch - big sage	1,040	0.8/100'	
9.	Big sage - silver sage	520	0.0/100'	300'-600' from ponderosa series
10.	Big sage - junegrass	1,300	0.4/100'	Less than 300' from ponderosa series
11.	Big sage - bluebunch wheatgrass	1,300	0.5/100'	300' from ponderosa series
12.	Big sage - junegrass	2,340	0.1/100'	
13.	Big sage - bluebunch wheatgrass	1,300	1.0/100'	Trace of ponderosa pine
		7,800	0.43 3/	(35%)
	TOTAL	28,340'		

*Survey conducted by Lew Myers - BLM Wildlife Management Biologist.

1/ None of these transects fell within the boundary of W. E. Mining Area "A" although all were in close proximity.
2/ Non-permanent belt transects 6' wide paced at varied length distances in each vegetation type. Figures represent total length for each vegetation type (May be more than 1 transect).
3/ Weighted mean.

Synopsis of Mule Deer Food Habits

In a study near Colstrip, Eustace (1971) found spring browse use to be only 43% of mule deer diet. Use of silver sage (Artemisia cana), big sage (Artemisia tridentata), rubber rabbitbrush (Chrysothamnus nauseosus), and juniper (Juniperus spp) declined. During late spring, increased use was made of rose (Rosa arkansana), snowberry (Symphoricarpos spp), and chokecherry (Prunus virginana). Use increased on forbs, particularly phlox (Phlox spp), long-plumed avens (Geum triflorum), an unknown buttercup (Ranunculaceae), and salsify (Tragopogon dubius). Early growing grasses comprised 39% of the diet.

In the Missouri River Breaks, an area fairly similar to Area A, Mackie (1970) found big sagebrush the most important spring forage plant for mule deer. The use of sage and other shrubs declined markedly with the onset of green-up. Sandberg bluegrass (Poa secunda) was heavily used. Eustace (1971) found the Colstrip area summer diet was 73% browse, 26% forbs, and a trace of grass. Important shrubs were chokecherry, sumac (Rhus trilobata), rose, and snowberry. Major forbs were geranium (Geranium spp), lettuce (Lactuca serriola), sweetclover (Melilotus officinalis), and alfalfa (Medicago sativa).

Ecological Consulting Service (1974a) assessed mule deer fall food habits, near the mining area, through analysis of 19 rumens. Browse, forbs, and grasses comprised 85% 5% and 6% of the diet, respectively. Major shrubs were skunkbush, snowberry, silver sage, and rabbitbrush. In a similar area, Knapp (1972) found 58% shrubs, 39% forbs, and 2%

grass in the fall diet. Major forbs were aster (Aster spp), thistle (Cirsium undulatum), dandelion (Taraxacum spp), and salsify (Tragopogon dubius). Major shrubs were skunkbush and snowberry.

Eustace (1971) reported 52% browse, 38% forbs, and 10% grass in the fall diet of Rosebud County deer. Snowberry, skunkbush, and chokecherry were major shrubs.

Data collected by Eustace (1971), Knapp (1972), and Mackie (1970) indicate reliance of wintering deer on browse. Major species were rubber rabbitbrush, silver sage, big sage, and juniper. Ponderosa pine (Pinus ponderosa) was also utilized. Browse use varied from 74% to 96% in these studies.

BREEDING BIRDS LISTED
BY HABITAT TYPE 1/
AND GENERAL ABUNDANCE 2/

	SPECIES	COMMON	UNCOMMON
A.	Ponderosa Woodland Habitats		
1.	Black-capped chickadee	X	
2.	Mountain chickadee		X
3.	Flicker	X	
4.	Red-headed woodpecker	X	
5.	Yellow-bellied sapsucker		X
6.	Downy woodpecker (R)		X
7.	Hairy woodpecker		X
8.	Pinyon jay	X	
9.	Chipping sparrow	X	
10.	White-crowned sparrow		X
11.	Song sparrow (R)	X	
12.	Lark sparrow (P)	X	
13.	Black-headed grosbeak (R)	X	
14.	Evening grosbeak		X
15.	Lazuli bunting	X	
16.	Red crossbill		X
17.	Rufous-sided towhee	X	
18.	Western tanager		X
19.	Bullock's oriole (R)	X	
20.	Audubon's warbler		X
21.	Western wood peewee	X	
22.	Olive-sided flycatcher		X
23.	Least flycatcher	X	
24.	Cassin's Kingbird (P)		X
25.	Gray catbird	X	
26.	Brown thrasher (R)	X	
27.	Warbling vireo (R)		X
28.	Red-eyed vireo (RP)	X	
29.	Towsend's solitaire		X
30.	Western bluebird		X
31.	Golden-crowned kinglet		X
32.	House wren (R)	X	
33.	Violet-green swallow	X	
34.	White-breasted nuthatch		X
35.	Red-tailed hawk (P)	X	
36.	Cooper's hawk (R)		X
	TOTAL	19	17

1/ Species common in two habitat types designated as either (R) = riparian, (W) = woodland, or (P) = prairie shrubs. Species common in three habitats designated as ubiquitous.

2/ A species was defined as common if recorded in at least three annual bird surveys between 1968 and 1974, and/or was readily observed during 1974 field work.

	SPECIES	COMMON	UNCOMMON
B.	Prairie Shrub-Grassland Habitats		
1.	Western meadowlark	X	
2.	Red-winged blackbird (R)	X	
3.	Brewer's blackbird	X	
4.	Brown-headed cowbird	X	
5.	Yellow-headed blackbird (R)		X
6.	Common grackle (R)	X	
7.	Starling	X	
8.	Lark bunting	X	
9.	Lark sparrow (W)	X	
10.	Vesper sparrow	X	
11.	Brewer's sparrow	X	
12.	Grasshopper sparrow	X	
13.	Savannah sparrow		X
14.	Baird's sparrow		X
15.	Clay-colored sparrow		X
16.	McCown's longspur		X
17.	Dickcissel		X
18.	Western Kingbird	X	
19.	Eastern Kingbird (R)	X	
20.	Cassin's Kingbird (W)		X
21.	Say's phoebe	X	
22.	Mountain bluebird		X
23.	Eastern bluebird		X
24.	Barn swallow (R)	X	
25.	Bank swallow		X
26.	Killdeer	X	
27.	Mountain plover		X
28.	Upland sandpiper		X
29.	Loggerhead shrike	X	
30.	Horned lark		X
31.	Mourning dove	X	
32.	Ring-necked pheasant (R)	X	
33.	Sharptail grouse	X	
34.	Hungarian partridge		X
35.	Sage grouse	X	
36.	Red-tailed hawk	X	
37.	Marsh hawk	X	
38.	Swainson's hawk		X
39.	Ferruginous hawk		X
40.	Short-eared owl		X
41.	Kestrel	X	
42.	Prairie falcon		X
	TOTAL	24	18

	SPECIES	COMMON	UNCOMMON
C.	Riparian Habitats		
1.	Yellow warbler	X	
2.	Common yellowthroat	X	
3.	Yellow-breasted chat	X	
4.	American redstart	X	
5.	Bank swallow (P)		X
6.	Barn swallow (P)	X	
7.	Tree swallow	X	
8.	Rough-winged swallow		X
9.	Violet-green swallow (W)	X	
10.	Eastern Kingbird (P)	X	
11.	Eastern phoebe		X
12.	Yellow-billed cuckoo		X
13.	Black-billed cuckoo		X
14.	Brown thrasher (W)	X	
15.	Veery		X
16.	Red-eyed vireo (W)	X	
17.	Warbling vireo (W)		X
18.	House wren (W)	X	
19.	Black-headed grosbeak (W)	X	
20.	Lazuli bunting (W)	X	
21.	American goldfinch	X	
22.	Yellow-headed blackbird (P)		X
23.	Red-winged blackbird (P)	X	
24.	Common grackle (P)	X	
25.	Bullock's oriole	X	
26.	Cooper's hawk (W)		X
27.	Ring-necked pheasant (P)	X	
28.	Downy woodpecker (W)		X
29.	Common snipe		X
30.	Spotted sandpiper		X
	TOTAL W=8, P=7	18	12
D.	Ubiquitous (found in variety of habitats)		
1.	House sparrow	X	
2.	Rock wren	X	
3.	Robin	X	
4.	Black-billed magpie	X	
5.	Common crow	X	
6.	Common raven	X	
7.	Common nighthawk	X	
8.	Cliff swallow	X	
9.	Great-horned owl		X
10.	Golden eagle		X
	TOTAL	8	2

BREEDING BIRD SURVEY
BUREAU OF SPORT FISHERIES AND WILDLIFE
MIGRATORY BIRD POPULATION STATION (BRANDENBURG, ROSEBUD CO.)
BY JIM PHELPS & BILL RONEY

	SPECIES	1968	1969	1970	1971	1972	1973	1974
1.	Red-tailed hawk			2	1		1	3
2.	Sparrow hawk	3	2	4	2	2	4	6
3.	Prairie falcon					1	1	
4.	Short-eared owl						2	
5.	Bald eagle				1			
6.	Killdeer	7	1	3	7	3	4	5
7.	Sharptail grouse			4				1
8.	Sage grouse	1			1	1		
9.	Say's phoebe		3	1		1		
10.	Upland plover							1
11.	Mountain plover						2	
12.	Common snipe			2	1			
13.	Spotted sandpiper			2				
14.	Common nighthawk	1	3	5	9	6	1	
15.	Red-shafted flicker	9	14	22		10	16	8
16.	Red-headed woodpecker	4	1	2	17	2	3	
17.	Eastern Kingbird	17	9	8	16	27	8	18
18.	Western Kingbird	15	10	22	15	22	7	9
19.	Cassin's Kingbird					3		
20.	Western wood peewee	4	7	9	2	15	7	5
21.	Horned lark			1	1			
22.	Olive sided flycatcher					2	1	
23.	Bank swallow				1			2
24.	Rough-winged swallow			1				3
25.	Barn swallow	2	1	5		2	1	10
26.	Cliff swallow	42		11		15	19	10
27.	Violet-green swallow		1		2		1	
28.	Tree swallow			3	2	15		
29.	Cliff swallow	11						
30.	Pinyon jay				3		7	
31.	Black-billed magpie		3	10	10	5	9	11
32.	Crow	10	4	1	4		9	
33.	Clark's nutcracker							
34.	Black-capped chickadee	1			4	1	2	7
35.	Mountain chickadee						2	
36.	House wren	17	13	17	21	33	9	11
37.	Rock wren					3	2	1
38.	Catbird		1	3		4	1	6
39.	Brown thrasher		1	1	3	3	6	2
40.	Yellow-billed cuckoo						2	5

	SPECIES	1968	1969	1970	1971	1972	1973	1974
41.	Robin		12	10	23	17	9	24
42.	Veery	5						
43.	Mountain bluebird						1	19
44.	Golden-crowned kinglet						1	
45.	Loggerhead shrike	3	4	2	2	3		
46.	Starling	5	6	1		1	14	8
47.	Red-eyed vireo	5			1			2
48.	Warbling vireo	2				1		
49.	Yellow warbler	9	6	7	14	32	33	35
50.	Audubon's warbler						19	4
51.	Yellowthroat	4	1	4	8	3	9	11
52.	Yellow-breasted chat	10	5	13	15	24	17	13
53.	American redstart		1		3		2	4
54.	House sparrow				4	3	1	2
55.	Western meadowlark	214	151	172	168	187	127	194
56.	Yellow-headed blackbird						1	23
57.	Red-winged blackbird	24	10	9	13	7	29	
58.	Bullock's oriole	4	7	3	6	9	9	6
59.	Brewer's blackbird	12	11	16	8	32	24	38
60.	Common grackle		1	3	2	2		11
61.	Brown-headed cowbird	4		21	22	5	4	4
62.	Western tanager						3	
63.	Black-headed grosbeak					3	2	3
64.	Evening grosbeak	8						
65.	Lazuli bunting	5	2	5	2	2	2	5
66.	American goldfinch	4	1	6	6	16	28	12
67.	Rufous-sided towhee	4	1	4	9	27	11	19
68.	Lark bunting	103	183	2	3	12	29	33
69.	Grasshopper sparrow		5	4	3	11	2	8
70.	Baird's sparrow			3	11			
71.	Vesper sparrow		1	3	2	7	7	12
72.	Lark sparrow	33	13	58	44	64	36	39
73.	Chipping sparrow		3	2	5	8	2	3
74.	Clay-colored sparrow			9				1
75.	Brewer's sparrow	3	1		9	2	28	20
76.	Song sparrow			3			1	3
77.	Townsend's solitaire					1		
78.	Red crossbill			4	5			
79.	White-breasted nuthatch						1	
80.	Ring-necked pheasant	43	69	35	33	21	46	46
81.	Least flycatcher		1	2		2		
82.	Mourning dove	21	29	16	64	30	31	24
83.	Common raven	1	1			2		1
84.	Eastern phoebe					2		
85.	Black-billed cuckoo		2					
	TOTAL SPECIES	37	43	50	48	52	53	50
	TOTAL NUMBERS	659	612	556	608	717	656	750

Reptiles and Amphibians Found in the Colstrip Area*

Common Name	Scientific Name
Plains spadefoot toad	*Scaphiopus bombifrons*
Great Plains toad	*Bufo cognatus*
Rocky Mountain toad	*Bufo woodhousei*
Boreal chorus frog	*Pseudacris triseriata maculata*
Leopard frog	*Rana pipiens*
Tiger salamander	*Ambystoma tigrinum*
Hog-nosed snake	*Heterodon nasicus*
Bull snake	*Pituophis catenifer*
Plains garter snake	*Thamnophis radix*
Common garter snake	*Thamnophis sirtalis*
Prairie rattlesnake	*Crotalus viridis*
Racer	*Coluber constrictor*

*Westinghouse, 1973a and 1973b.

LIST OF ANIMALS OBSERVED IN THE VICINITY OF COLSTRIP

	Scientific Name	Common Name
AMMALS:	*Antilocapra americana*	Pronghorn antelope
	Canis latrans	Coyote
	Cynomys ludovicianus	Black-tailed prairie dog
	Erethizon dorsatum	Porcupine
	Eutamias minimus	Least chipmunk
	Lepus townsendii	White-tailed jackrabbit
	Lynx rufus	Bobcat
	Marmota flaviventris	Yellow-bellied marmot
	Mephitis mephitis	Striped skunk
	Microtus ochrogaster	Prairie vole
	Mus musculus	House mouse
	Mustela frenata	Longtail weasel
	Myotis lucifugus	Little brown bat
	Odocoileus hemionus	Mule deer
	Odocoileus virginianus	White-tailed deer
	Ondatra zibethicus	Muskrat
	Peromyscus maniculatus	Western deer mouse
	Procyon lotor	Raccoon
	Sorex cinereus	Masked shrew
	Spermophilus tridecemlineatus	Thirteen-lined ground squirrel
	Sylvilagus audubonnii	Desert cottontail
	Taxidea taxus	Badger
	Thomomys talpoides	Northern pocket gopher
	Vulpes vulpes	Red fox

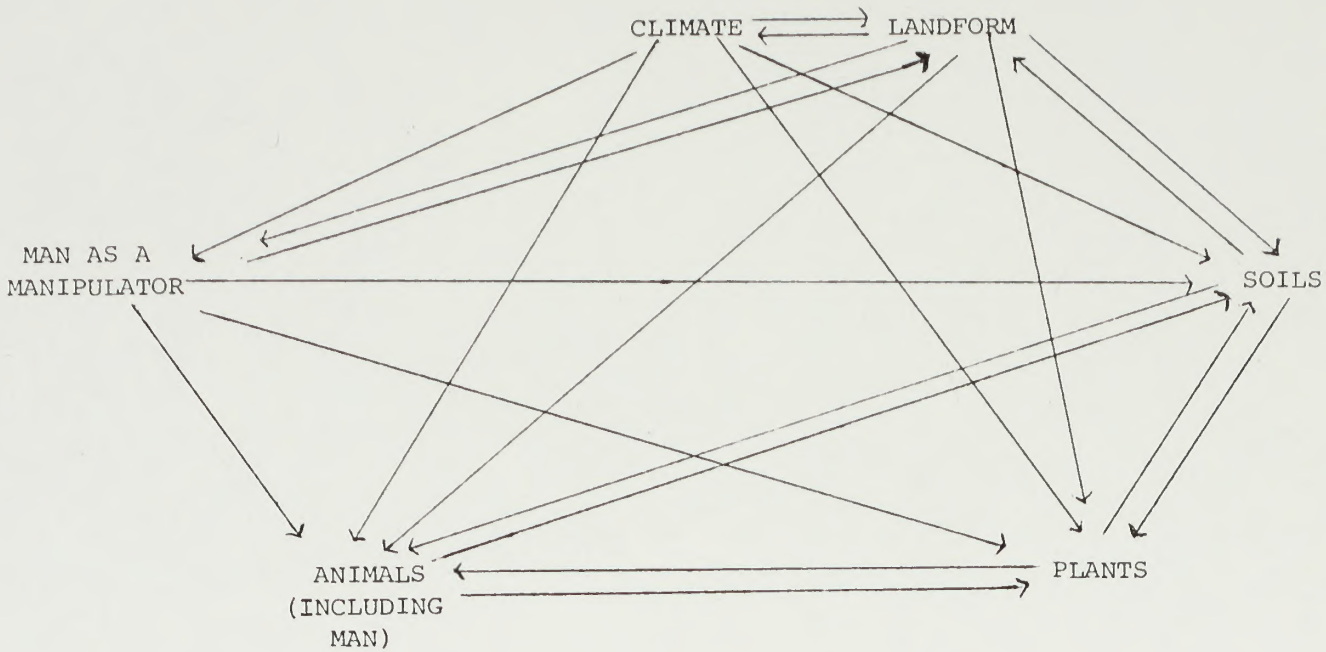
Adapted from "10 x 20 Colstrip Annual Report 1974 - Montana Power Company - Project 71-23-A," by Ecological Consulting Serivce. December 31, 1974.

SMALL MAMMAL SPECIES TRAPPED AT 10 TRAPLINE SITES
DURING LATE JULY AND EARLY AUGUST 1974 ON WESTERN ENERGY'S AREA A_1

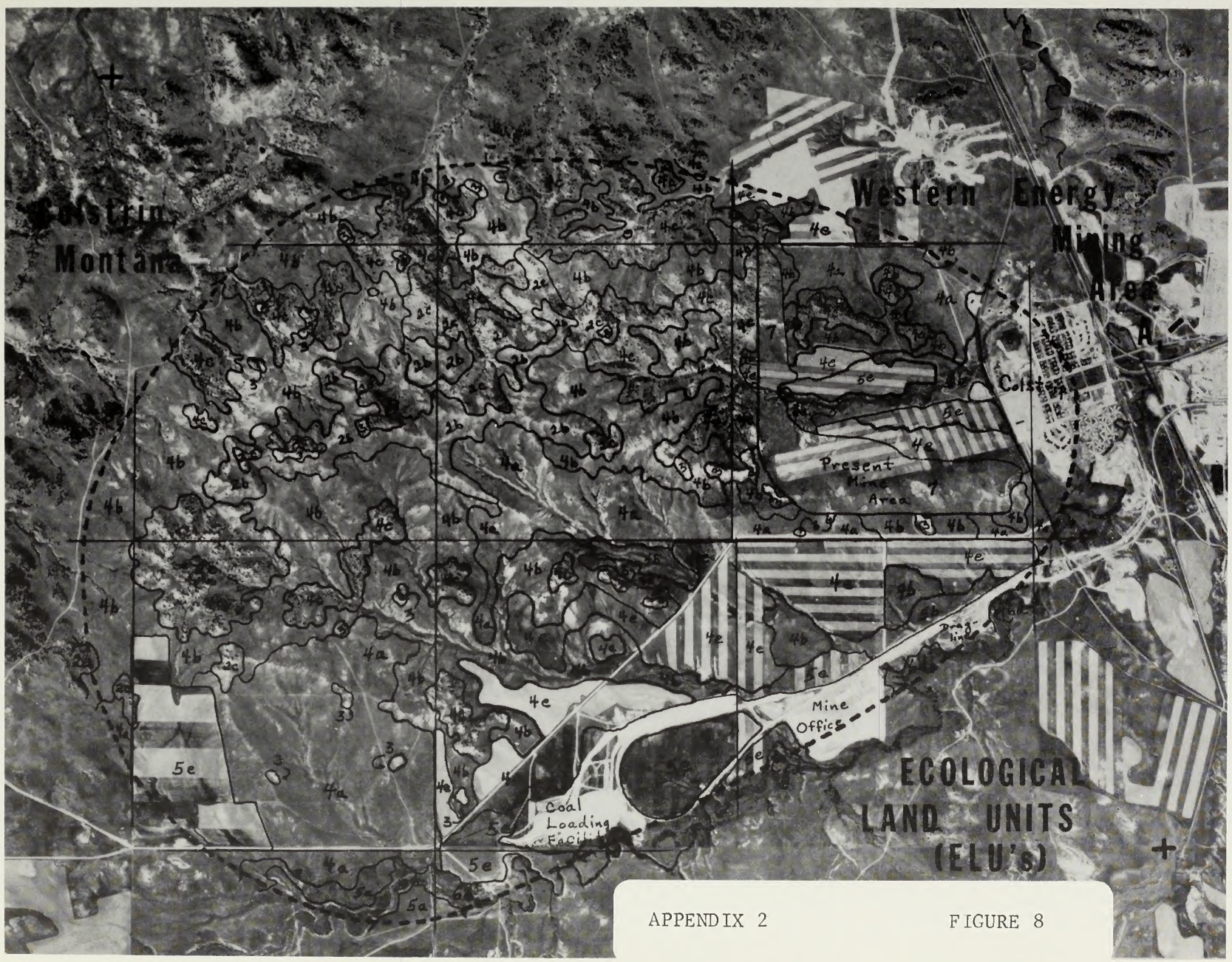
Habitat Type and Code Number	Location	Species	Number	Sex		Age			Catch/Trap Night[1]
				M	F	Adult	Subadult	Juvenile	
Grassland (111)	L.8, 11.9	--	--	–	–	–	--	--	--
Big Sagebrush-Grassland (211)	L.1, 11.6	*Peromyscus Maniculatus*	5	1	4	2	--	3	1.3
	L.1, 11.6	*Microtus Ochrogaster*	1	–	1	1	--	--	0.3
Silver Sagebrush-Grassland (212)	L.9, 11.9	--	--	–	–	–	--	--	--
Rhus-Grassland (213)	L.5, 11.9	*Peromyscus Maniculatus*	16	7	9	7	--	9	4.0
	L.5, 11.9	*Microtus Ochrogaster*	1	1	–	1	--	--	0.3
Ponderosa Pine (351)	K.8, 11.7	*Peromyscus Maniculatus*	2	–	2	1	--	1	0.5
Ponderosa Pine Juniper (352)	L.2, 11.5	*Peromyscus Maniculatus*	6	4	2	4	2	--	1.5
Saltbush-Rabbitbrush (215)	K.9, 11.8	*Peromyscus Maniculatus*	9	4	5	9	--	--	2.3
Creek Bottom (220)	M.1, 12.1	*Peromyscus Maniculatus*	3	2	1	3	--	--	0.8
	M.1, 12.1	*Microtus Ochrogaster*	2	2	0	2	--	--	0.5
Hay Cropland (510)	K.3, 12.9	*Peromyscus Maniculatus*	9	5	4	2	4	3	2.3
Grain Cropland (530)	L.4, 11.5	*Peromyscus Maniculatus*	6	3	3	4	1	1	1.5
Totals		*Peromyscus Maniculatus*	56	26	30	32	7	17	
		Microtus Ochrogaster	4	3	1	4			
							Average	*Peromyscus Maniculatus*	1.4
								Microtus Ochrogaster	0.1

[1] Catch/Trap Night = the average number of individuals of a species of small mammal caught per trapping night at each trapline consisting of 10 traps.

* Adapted from "Report to Western Energy Company - 1975 mining permit requirements for wildlife and vegetation areas A_1 and E_2 - Project 82-23-A," by Ecological Consulting Service. August 15, 1974.



Each ecological land unit (ELU) has a relationship between living and non-living components. Each component is influenced to some degree by the others.



APPENDIX 2 FIGURE 8

Mesa Butte Top-Steppe Shrub ELU. Mesa Butte Steep Side Slope-Steppe Shrub ELU in the foreground. Western Energy Mining Area A - Section 31. 02/17/76.

Mesa Butte Steep Side Slope-Xerophytic Forest (background) and Mesa Butte Steep Side Slope-Steppe Shrub (foreground) ELU's. Western Energy Mining Area A - Section 31. 02/17/76.

Mesa Butte Steep Side Slope-Xerophytic Forest ELU. Western Energy Mining Area A - Section 31. 02/17/76.

Mesa Butte Steep Side Slope-Steppe Shrub ELU. Western Energy Mining Area A - Section 31. 02/17/76.

Massive Sandstone Bluff ELU. Western Energy Mining Area A - Section 31. 02/17/76.

Dissected Mid Slope-Steppe Grassland ELU. Western Energy Mining Area A - Section 6. 02/17/76.

Dissected Mid Slope-Steppe Shrub (Big Sagebrush aspect in foreground) and Dissected Mid Slope-Xerophytic Forest (background) ELU's. Western Energy Mining Area A - Section 31. 02/17/76.

Dissected Mid Slope-Steppe Shrub (Skunkbush Sumac-Silver Sagebrush aspect) ELU. Western Energy Mining Area A - Section 1. 02/17/76.

Dissected Mid Slope-Xerophytic Forest ELU. Western Energy Mining Area A - Section 1. 02/17/76.

Dissected Mid Slope-Cropland (Fallow field aspect) ELU. Coal mine spoils in background. Western Energy Mining Area A - Section 4. 02/17/76.

Dissected Mid Slope-Cropland (Wheat field and fallow strip aspect in background) and Alluvium/Terrace-Cropland (alfalfa hay fields aspect in foreground) ELU's. Western Energy Mining Area A - Section 5. 02/17/76.

Alluvium/Terrace-Steppe Grassland ELU. Western Energy Mining Area A - Section 7. 02/17/76.

Alluvium/Terrace-Steppe Shrub (Silver Sagebrush aspect in foreground) and Dissected Mid Slope-Steppe Shrub (Silver Sagebrush aspect in background) ELU's. Western Energy Mining Area A - Section 4. 02/17/76.

Current Flood Plain-Mesophytic Forest ELU. East Fork of Armells Creek. Western Energy Mining Area A - Section 4. 02/17/76.

Current Flood Plain-Mesophytic Forest ELU. East Fork of Armells Creek. Western Energy Mining Area A - Section 3. 02/17/76.

Stockwater pond. Western Energy Mining Area A - Section 31. 02/17/76.

Alluvium/Terrace-Cropland (Alfalfa hay field aspect in foreground) ELU and the coal storage and loading facilities (background). Western Energy Mining Area A - Section 5. 02/17/76.

Coal mine office and equipment shops. Western Energy Mining Area A - Section 4. 02/17/76.

Coal mine spoil banks, active pit, and high wall. Western Energy Mining Area A - Section 33. 02/17/76.

Initial overburden removal (foreground) and the Colstrip town site and power plant complex (background). Western Energy Mining Area A - Section 33. 02/17/76.

Diversity Index

Diversity, simply defined, is the quality, or state, of "being different," or "varied." Diversity of habitats in an ecosystem is generally a desirable characteristic since a wide variety of habitats provides a wide variety of "niches," and a wide variety of "niches" supports a diversified floral and faunal community. For any single species, an optimum mixture of habitat components also exists. Leopold (1933) related to habitat diversity in terms of "edge-effect" in his Law of Interspersion for game populations. He stated, "The potential density of game of low radius requiring two or more types is, within ordinary limits, proportional to the sum of the type peripheries."

Patton (1975) developed a quantitative expression of Leopold's Law of Interspersion. Since the geometric figure with the greatest area and the least perimeter, or "edge," is a circle, Patton established the ratio of circumference to area of a circle as a given index value of one. He then derived a formula to compute a comparable index for any area to collate with a circle. Any index value larger than one is a measure of irregularity and can be used as a diversity index (DI). Patton's formula to set the ratio equal to one is:

$$\frac{C}{2\sqrt{A \cdot \pi}} = 1$$

where C is the circumference, A is the area, and is 3.1416. The next step is to restate the formula for habitat diversity as:

$$DI = \frac{TP}{2\sqrt{A \cdot \pi}}$$

where TP is the total perimeter around the area plus any linear edge within the area.

The ELU's of Area A (Appendix 2, Figure 8) were utilized to develop a diversity index for the entire Area A and the E½ of Section 32, alone. Linear distance around the areas and each ELU were determined with a map measurer. The calculations were as follows:

E½, Sec. 32 -

$$DI = \frac{50972 \text{ ft}}{2\sqrt{(43560 \text{ ft}^2/\text{acre})(320 \text{ acres})(3.1416)}}$$

$$= 3.85 \text{ (6 ELU's)(320 acres)}$$

Entire Area A -

$$DI = \frac{438240 \text{ ft}}{2\sqrt{(43560 \text{ ft}^2/\text{acre})(3814 \text{ acres})(3.1416)}}$$

$$= 9.59 \text{ (15 ELU's)(3814 acres)}$$

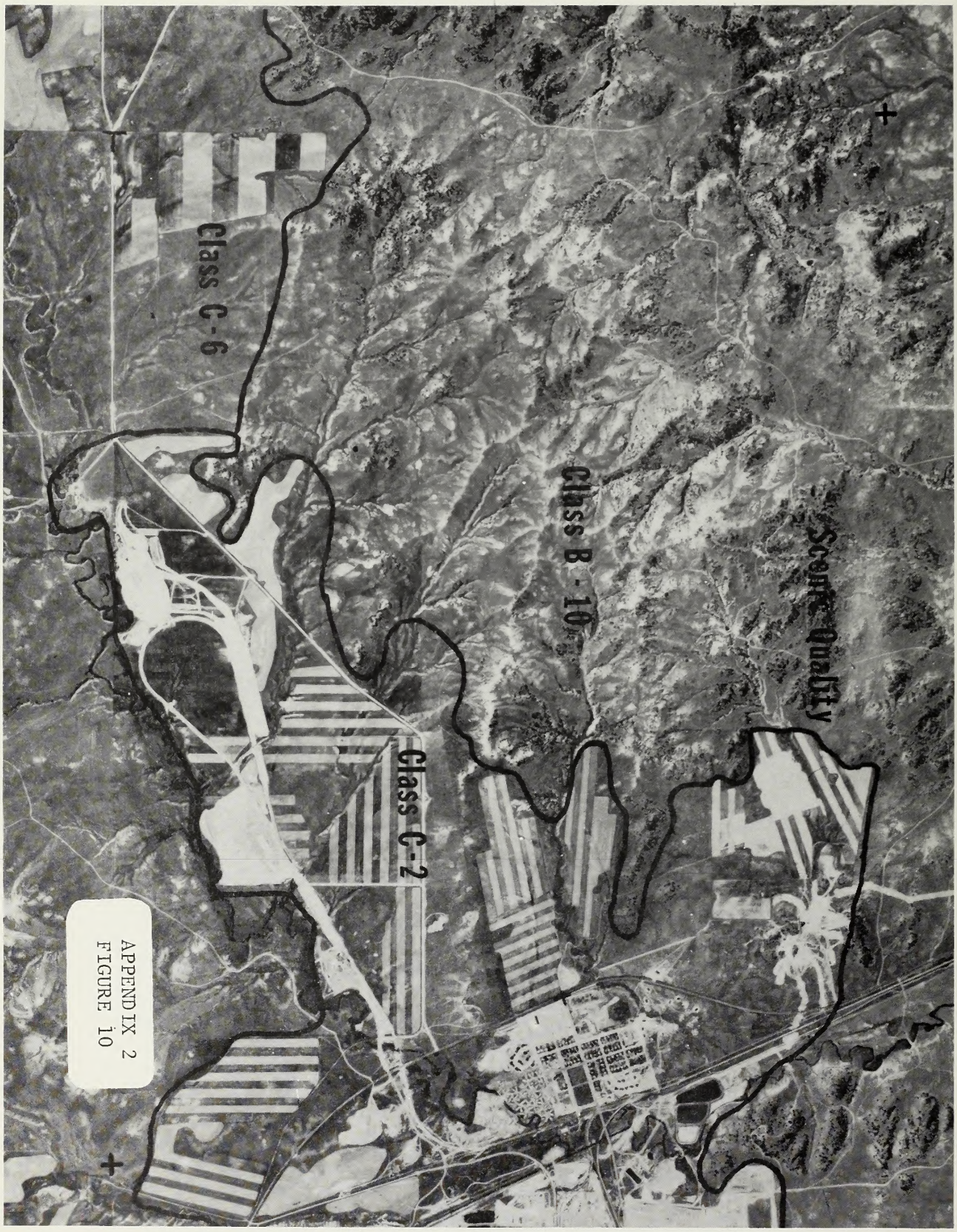
These calculations indicate that, in terms of ELU's, the E½ of Section 32 and the entire Area A are 3.85 and 9.59 times, respectively, more diverse (contain more "edge") than a circle. However, how does the E½ of Section 32 compare in terms of diversity to any other 320 acre block of Area A? For this determination a diversity index value was calculated for an "average" 320 acre block of Area A. Three hundred and twenty acres represent 8.4% of the entire Area A acreage (3,814 acres). The calculation was as follows:

"Average" 320 acre block of Area A -

$$DI = \frac{(438240 \text{ ft})(0.084)}{2\sqrt{(43560 \text{ ft}^2/\text{acre})(3814)(0.084)(3.1416)}}$$

$$= 2.78 \text{ (15 ELU's)("average" 320 acres of Area A)}$$

Comparing this calculation with the DI for the E½, Section 32, indicates that the E½ of Section 32 is 38% more diverse than the "average" 320 acre block of Area A. Knowing this fact provides insight to evaluating the relative environmental impacts of mining coal under the E½ of Section 32, as well as providing a basis for assigning relative impact ratings. This fact also alludes to the complexity of assuring adequate reclamation for the E½ of Section 32 following coal mining.



APPENDIX 2
FIGURE 10

Visual Quality Ratings

The following is a description of the procedures involved in determining Visual Quality.

1. All areas which contain interspersed national resource lands within the District boundary, not just BLM lands, were evaluated. In order to help eliminate some of the subjectivity, an interdisciplinary team was formed to do the evaluation.

2. The area was compared to the region in which it is located, not just the planning unit.

3. It was kept in mind that the size of the area to be evaluated was not critical. However, it was practical to consider rating an entire area in one session. To do this effectively, it was necessary that the people doing the rating were very familiar with both the scenery in the area and with the concepts of this rating system.

4. The area was divided into scenery units.

5. Key factors of scenery were applied to each unit separately. Each key factor was applied to the unit as a whole, not from any one location or even from a bird's-eye view.

Scenery Quality Inventory Chart

KEY FACTORS	RATING CRITERIA AND SCORE		
(1) LAND FORM	Vertical or near vertical cliffs, spires, highly eroded formations, massive rock outcrops, severe surface variation. 4	Steep canyon walls, mesas, interesting erosional patterns, variety in size & shape of land forms. 2	Rolling hills, foothills, flat valley bottoms. 1
(2) COLOR	Rich color combinations variety or vivid contrasts in the color of soil, rocks, vegetation or water. 4	Some variety in colors and contrast of the soil, rocks & vegetation, but not dominant. 2	Subtle color variations, little contrast, generally muted tones. Nothing really eye-catching. 1
(3) WATER	Still, chance for reflections or cascading white water, a dominant factor in the landscape. 4	Moving and in view or still but not dominant. 2	Absent, or present but seldom seen. 1
(4) VEGETATION	A harmonious variation in form, texture, pattern, and type. 4	Some variation in pattern and texture, but only one or two major types. 2	Little or no variation, contrast lacking. 1
(5) UNIQUENESS	One of a kind or very rare within region. 6	Unusual but similar to others within the region. 2	Interesting in its setting, but fairly common within the region. 1
(6) INTRUSIONS	Free from aesthetically undesirable or discordant sights and influences. 2	Scenic quality is somewhat depreciated by inharmonous intrusions but not so extensive that the scenic qualities are entirely negated. 1	Intrusions are so extensive that scenic qualities are for the most part nullified. -4

Scenery A = 15-24

Scenery B = 10-14

Scenery C = 1-9

EXPLANATION OF RATING CRITERIA

(1) Land Form or topography becomes more interesting as it gets steeper and more massive. Examples of outstanding land forms are found in the Grand Canyon, the Sawtooth Mountain Range in Idaho, the Wrangle Mountain Range in Alaska, and the Rocky Mountain National Park.

(2) Color. Consider the overall color of the basic components of the landscape (i.e., soil, rocks, vegetation, etc.) as they appear during the high-use season. Key factors to consider in rating "color" are variety, contrast, and harmony.

(3) Water is the ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.

(4) Vegetation. Give primary consideration to the variety of patterns, forms, and texture created by the vegetation.

(5) Uniqueness. This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique within any one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing scenery - the uniqueness factor can be used to recognize this type of area and give it the added emphasis it needs.

(6) Intrusions. Consider the impact of man-made improvements on the aesthetic quality. These intrusions can have a positive or negative aesthetic impact. Rate accordingly.

INSTRUCTIONS (See .1 for general procedures.)

Purpose: To rate the aesthetic quality of the scenic resource on all BLM lands.

How to Identify Scenery Value: All Bureau lands have scenic value.

How to Determine Minimum Suitability: All BLM lands are rated for scenic values. Also rate adjacent or intermingling non-BLM lands.

How to Delineate Rating Areas: Consider the following factors when delineating rating areas:

1. Like physiographic characteristics (i.e., land form, vegetation, etc.)
2. Similar visual patterns, texture, color, variety, etc.
3. Areas which have a similar impact from intrusions (i.e., roads, structures, mining operations, or other surface disturbances).

1. Date 12/30/75

2. Rater McTaggart

3. State Montana

4. District Miles City

5. Plan Unit (Colstrip) So. Rosebud Area A)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

QUALITY EVALUATION SCORESHEET

6. Recreation Activity: Scenery

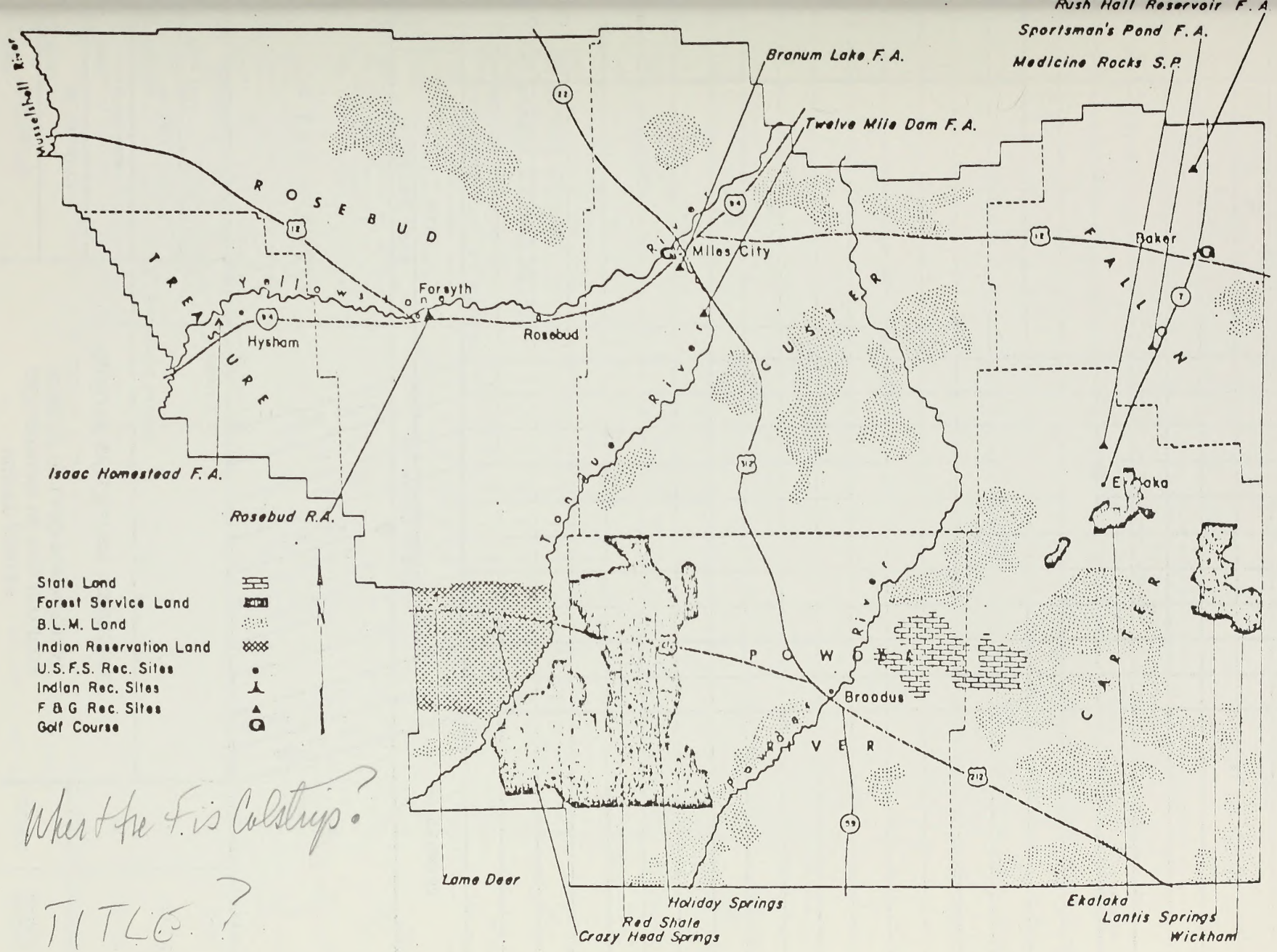
CLASS	SCORE RANGE
7	
A	15-24
B	10-14
C	1-9

8. KEY FACTORS

9. RATING AREA NO. (a)	NAME (b)	Land Form	Color	Water	Vegetation	Uniqueness	Intrusions			11. TOTAL SCORE	12. CLASS	13. REMARKS
		10. POINT MAXIMUM										
		4	4	4	4	6	2					
C-2	Colstrip, spoils, mining, agriculture area	1	1	1	1	2	-4			2	C	
C-6	Armell's Creek Valley	1	1	1	1	1	1			6	C	
B-10	Wooded Uplands	2	2	1	2	1	2			10	B	

(Instructions on reverse)

Form 6110-10 (August 1972)



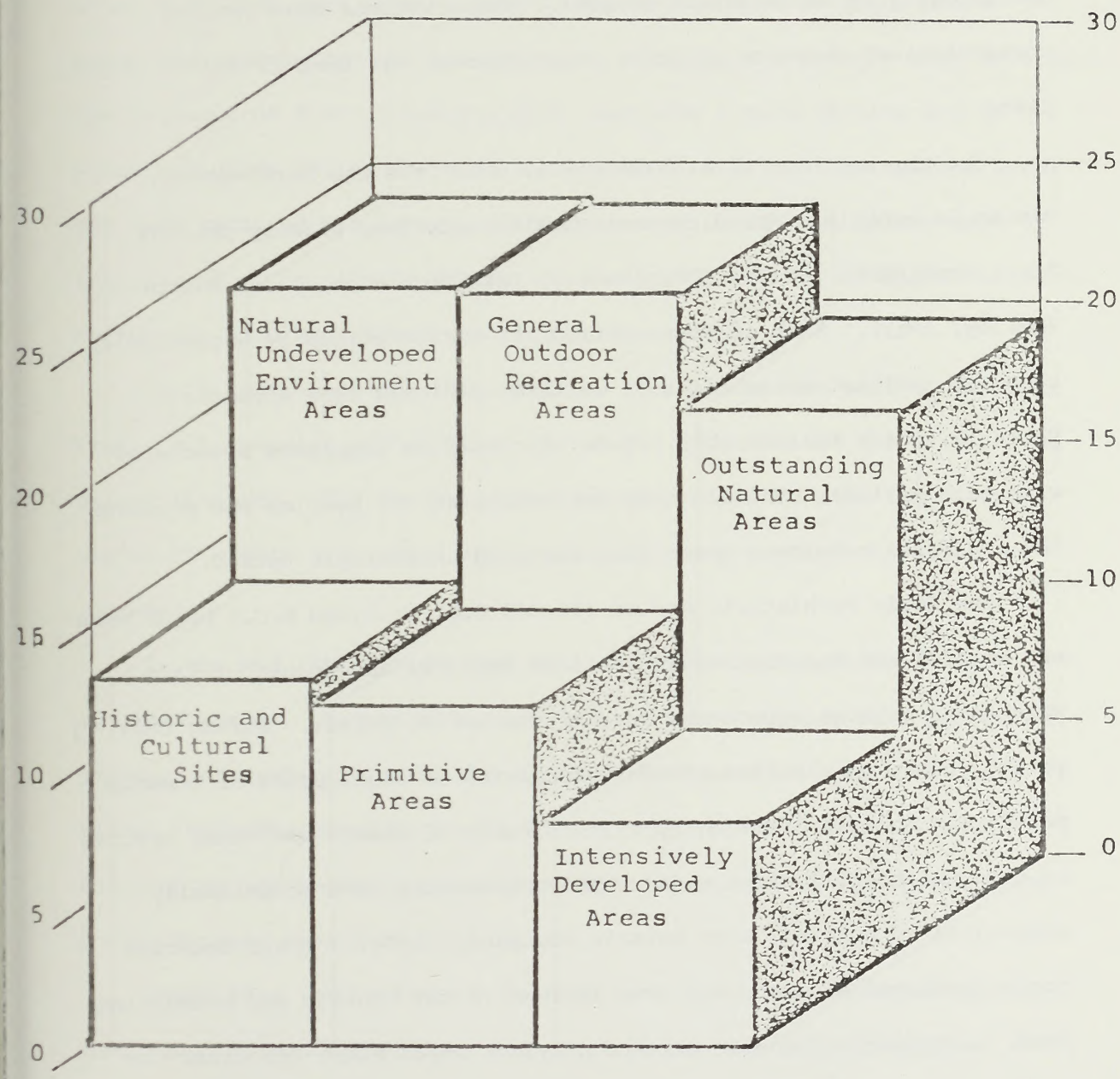
Where the F is Colstrip?

TITLE?

PLANNING REGION 3

PLANNING REGION 3

eferences for Selected Types of Recreation Areas by Montana Residents
Yearly Totals



Numbers indicate a weighted percent based on the number of responses to first, second, and third preferences.

Archaeological and Historical Summary

The prehistory of the proposed mining area is best understood in the context of the cultural development of the Northwest Plains and more specifically of southeastern Montana. These regions have yielded archaeological evidence of man's presence over the last 12,000 to 13,000 years.

The present body of archaeological data from the Northwestern Plains is usually ordered chronologically into four primary periods: Early Prehistoric, Middle Prehistoric, Late Prehistoric, and Historic (Mulloy, 1958). Each of these periods is characterized by a particular range of artifact assemblages or culture complexes (see Appendix 2, Table 12, which follows this figure, for culture complexes associated with each period). The economic activities of the peoples who produced the artifacts have been speculated for each chronologic period.

The Early Prehistoric Period (10,000 B.C. to 5,500 B.C.) began when man entered the Western Hemisphere from Asia via an expanse of land which once existed across the area of the Bering Strait. During this period, human populations probably consisted of small bands of nomadic pedestrian hunters of mammoth, extinct forms of bison, and other species of game which still exist today. These bands may have occasionally cooperated in hunting large animals (Jennings, 1974). Their material goods consisted of stone and bone implements for hunting and processing food. A wetter and cooler climate provided ample plant resources for game (Wedel, 1964).

During the Middle Prehistoric Period (5,500 B.C. to 500 A.D.), man's way of life changed somewhat from the previous period. Although still organized in small nomadic bands, people seem to have occupied caves and rockshelters. They may have returned to utilize the same camp sites more than once (Smith, 1974). The modern form of bison was a major food source and new techniques of trapping the animals were developed The presence of food grinding stones indicates a more diverse use of plant resources during the Middle Prehistoric Period. The bow and arrow may have replaced the spear and spear thrower during the latter part of this period. The climate during the early parts of the Middle Prehistoric Period may have been hotter and dryer than today.

While continuing the life style of the Late Middle period, the Late Prehistoric peoples (500 A.D. to 1800 A.D.) expanded the use of bison as a food resource. The bow and arrow gained prominence as a tool. The number of prehistoric sites and presumably human populations began to increase.

In the mid 18th Century the Indians of the Northwestern Plains acquired horses. Before this time, all of these peoples were pedestrian hunters and gatherers. The dog may have been used as a pack or draft animal beginning sometime in the Middle Prehistoric. However, the addition of the horse to the extant cultural base of Plains Peoples had a considerable impact on life styles.

Equestrian (horse-riders) hunters used their new transportation to hunt bison more efficiently. Groups of people may have accumulated "economic surpluses" of foods, thus expanding their range, mobility, and

populations. This surplus may in turn have precipitated the development of an extensive trade pattern which began just prior to the entrance of white man onto the Northwestern Plains (Brown, 1969). The economic pattern of the Indians was also influenced in that the ownership of horses became a source of individual and group wealth.

The advent of white men onto the Northwest Plains marked the beginning of the Historic Period. In the 18th Century, the French traders such as Verendrye were the first to make contact with Plains Indian tribes. Fur trade initiated by the French Canadians was subsequently developed by free traders and representatives of the British Hudson's Bay Company. Increased French and British influence in the region prompted Americans to launch the Lewis and Clark Expedition in 1804. American fur trade was expanded after this famed expedition by the Missouri River Company (1808-1821), the American Fur Company, and other trading posts and forts.

In the area which was to become southeastern Montana, a group of trappers established a fort in 1807 named after their leader, Manuel Lisa. More forts were erected in the vicinity over the next forty to fifty years of the fur trade (Appendix 2, Figure 12). These early white activities undoubtedly influenced the economic behavior and movements of Indians but the basic Indian cultural-economic pattern of equestrian bison hunting remained the same.

The Montana gold rush of the 1860's precipitated the first great influx of whites. As the number of immigrants increased, pressures developed between whites and Indians which set the stage for the Indian

wars of the 1870's. Southeastern Montana became a focal point for many of these hostilities.

In 1876 the U.S. Army began a campaign to move Indians back to reservations which had been established earlier. Some Sioux and Cheyenne groups had opposed their restriction to reservations and moved into southeastern Montana. The pursuit of these people led to General Crook's encounter with the Northern Cheyenne on June 17, in the Battle of the Rosebud. On June 25, Lt. Col. George Custer's command engaged a large encampment of Sioux and Cheyenne in the famous Battle of the Little Bighorn.

THE NORTHERN PLAINS CULTURE SEQUENCE

(From Lahren and Sorrells, 1970)

THE EARLY PREHISTORIC PERIOD
(ca. 10,000 - 5,500 B.C.)

COMPLEXES	AGE	KNOWN SITES
Clovis	10,000-9,000 BC	Anxick Site, Montana
Folsom	9,000-8,500 BC	MacHaffie Site, Montana
Agate Basin	8,500-6,000 BC	Agate Basin, Wyoming; Hell Gap, Wyoming; Myers-Hindman, Montana; Waterton Park, Alberta
Hell Gap	8,000-7,500 BC	
Alberta	?	?
Cody Complex (Scottsbluff-Eden)	7,000-6,500 BC	Fletcher, Alberta Horner, Wyoming MacHaffie, Montana

THE MIDDLE PREHISTORIC PERIOD
(ca. 5,500 B.C. - A.D. 500)

COMPLEXES	AGE	KNOWN SITES
Bitterrot	5,500-3,000 BC	Numerous
Oxbow	3,000 BC	Numerous
McKean	3,000 BC	Numerous

Duncan	2,000 BC	Numerous
Hanna	1,500 BC	Numerous
Pelican Lake	1,500 BC - AD 100-500	Numerous
Besant	AD 1 - AD 700	Numerous
Avonlea	AD 1 - AD 800	Numerous

THE LATE PREHISTORIC PERIOD
(ca. AD 500 - AD 1800)

COMPLEXES	AGE	KNOWN SITES
Plains Side-Notch	AD 700 plus	Numerous
Plains Triangular	AD 700 plus	Numerous
Trade Metal	AD 1750 plus	Numerous

THE HISTORIC PERIOD
(ca. AD 1750 plus)

COMPLEXES	
Crow	
Shoshoni	
Blackfoot	
Cheyenne	
Arikara	
Atsina	
Plains Cree	
Assiniboin	
Dakota	
Lewis and Clark	1806

Upper Armells Creek in the History of Southcentral Montana

by

Joann Stephan

(from Fredlund and Fredlund, 1974)

This land can be sterile; hostile. Winter blizzards storm out of the arctic, turning the land white and frozen. Antelope and deer, cattle and sheep starve trying to break through the frozen crust. Summer suns parch and sear the plains to an even-fried brown. Drought and heat shrivel grass before it has a chance to grow. But the land is also beautiful. Finis Daughtrey must have thought that many mornings as he sat on his front porch, sipping a cup of coffee, watching the sun climb over the high sandstone ridge east of his homestead. He saw the miles of yellow clover that hid half a horse--the grass lush and sweet and green--the high bluffs and the pines which grew on them. Finis saw the land both ways, barren and fruitful. So did Frank Clark who rode through in 1883 on his way to Idaho. That year he said the land was so dry "a jack rabbit would have to pack his lunch." On his way back with a trail herd in 1886, the drovers dined on frog legs. Maybe that's just a story, but anyone who has lived in that country knows how quickly it can alter. It is a land of change--always change. Winters that could freeze the tundra; droughts that could dry up a desert; rain, and soil, and climate the produce grass, crops, and livestock as good as any in the world.

Buffalo, antelope, elk, and the wolves and grizzlies which preyed on them migrated across the territory. If forage was good, they fattened and increased in number dramatically. String a few years of drought together, and the herds drifted to find sufficient grass. They became scrawny, fewer of the yound survived, and disease (which seldom hits hard in a well-fed herd) decimated entire populations. Indians probably fared as well as the herds--prospering during the wet periods but suffering hunger and disease in the droughts.

Armell's Creek was first "called by the Indians the Little Bighorn" according to Lewis and Clark's journals (Coues, 1965:1158), but in 1893 it was "known as Armell's, Emill's, Emmel's, Emmette's, etc., river" (Coues, 1965: 1158 footnote 2). In 1859 Captain Raynolds' crew of geologists and surveyors named this stream Emmel's Creek after one of the early fur traders, Michael Immell who was killed near Pryor Creek when ambushed by the Blackfeet in 1823 (Brown, 1961: 61-62, 114). As was common in those days, names, spellings, and stories changed often, occasionally posing great problems for the historian of later times.

Regardless of these difficulties, Armell's Creek gained prominance when Fort Alexander was built opposite the mouth of the creek on the Yellowstone River in 1842. For eight years, this was the major fort along the Yellowstone for the American Fur Company until 1850 when Fort Sarpy then took over as the trading post serving the Crow nation (Brown, 1961:77). Although the traders lived in forts and with relative comfort, the life was hard, often boring, but at times more exciting than anyone cared to admit. Since the area was contested by both the Blackfeet and the Crow and was, as well, subject to raids from other tribes, the forts

along the Yellowstone were considered dangerous assignments. Also, because the forts were stationary they suffered from lack of game which was quickly killed off near the fort, lack of wood which was quickly used up for fuel, and from constant attack and harrassment by various tribes who had no difficulty finding an easy target. Just as the Indians moved from one area to another, the trappers moved seasonally with them, suffering the yearly changes the land had to offer: only the traders remained year 'round and suffered the condequences.

Cowmen lived the same kind of migratory life when they first trailed herds into Montana (still mostly Unorganized Territories) in the late 1850's. Enterprising men bought worn out, footsore oxen and cattle from the pilgrims on the Oregon or Mormon Trail and brought them north into western Montana to fatten. They then returned the livestock to "the Road" to barter one sound head for two "tenderfoots." It was an itinerant life but very profitable. With the discovery of gold, influx of miners, and the resulting demand for beef, herds were pushed east across the divide. Fifteen years after the first cattle were brought into the territory, the western valleys were getting crowded.

The boom days of the ranching industry were still to come. Eastern Montana's 60,000,000 square miles of grasslands proved as capable of raising cattle as the mountain valleys in the west. As those plains were cleared of bison, Indains defeated in wars and limited to reservations, the so-called "Great American Desert" began looking like Paradise. Railroads stretched their tracks across the continent, and the markets of St. Paul, Chicago, and the East became accessible. Propagandizing

and advertising by the railroads aroused interest in the ranching industry and brought millions of dollars of eastern and even foreign capital to invest in cattle. The boom was on!

In less than 30 years Montana's cattle industry grew from a couple of hundred scraggly animals to over one million head. For two-thirds of this number, Miles City was the railhead. The Tongue, Powder, Rosebud, Armell's, O'Fallen, and the Pumpkin, all tributary to the Yellowstone, served as new homes for the longhorns and shorthorns driven in from as far away as Texas and California. The men who trailed in those herds were as well known as the famous drainages they settled. Granville Stuart moved from the Deer Lodge to the plains east of the Judith Mountains. In 1881 Armell's Creek was the home ranch for James Fergus and in 1883 for the Green Mountain Stock Company. Carpenter and Robinson set up on the Rosebud. Dan Floweree, Nelson Story (the first to bring up the Texas longhorns in 1866), Conrad Kohrs, Poindexter, and Orr, all settled in this country. Eastern and foreign companies were well represented. The Concord Cattle Company of New Hampshire, the Chicago and Montana, Iowa and Montana, Illinois and Montana, Rosenbaum Brothers of Minneapolis, and the Grinell Cattle Company were all out to make fast, big money on Montana grass. As an example of how far-reaching that interest was, the Powder River Cattle Company took 1½ million dollars out of England and set it to growing in the form of cattle on the Rosebud.

Wire fences did not separate ranches in those days. The land had not been surveyed yet, so squatting was the law. Boundaries were usually

determined by drainages and the height of land between. Descriptions such as the lower valley west of Pumpkin Creek, or between Great and Little Porcupine Creeks were common; but all had a home ranch. A brand was necessary because in a storm the cattle could drift many miles and herds would intermingle. Rustlers might round up a whole herd, but losses averaged 5%. In 1884, Grnville Stuart led a group of vigilantes, sometimes known as Stuart's Stranglers, to help rid the country of these thieves. Sometimes there was also a rancher who had a long rope. Spring and fall round-ups served to sort out the herds but were mainly to brand calves, determine winter losses in the spring, and to cut out steers and dry cows for market in the fall. Often area ranchers worked together at round-ups. At least, a representative attended each neighbor's so he could gather his outfit's errant stock and drive it home.

Obviously, the cattle business was very successful and lucrative, for it had enjoyed good luck during the first years. Drought was infrequent, prairie fires burned up some winter range, but the land was big and more range could be found. As the range filled up, however, luck seemed to change too. Then the droughts came. The early '80's had one or two. Overstocking limited the grass per animal unit and the cattle weren't quite so fat. In 1885 market prices fell, fewer head were shipped to market, and, consequently, the problem got worse. The spring and summer of 1886 brought very little rain and very little grass. Cattle went into the winter a little ribby. And then winter hit--this year in November. It continued through December and into January with wind and cold snow. Cattle were already dying. Early January brought

a chinook that melted some snow, but the end of January brought one of the worst blizzards Montana has ever seen. The melting snow suddenly crusted and iced over in -45 degree temperatures, and then was covered by more snow blown by more cold winds. A few more February storms climaxed Nature's show of fickleness and destroyed about 75% of Montana's cattle. Spring thaws revealed thousands and hundreds of thousands of carcasses. Twenty million dollars had been lost. Many ranches folded; most of the eastern and foreign capital investors lost their interest. The boom suddenly seemed more like a bust.

Some men hung on to rebuild, but with different tactics. Wire fenced hay fields and stacks, so that if catastrophe tried to strike again, it might be partially averted. Pierre Wibaux decided that the cattle which had survived that winter were hardy and acclimatized and would survive any weather, so he bought up as many head as he could. Many acres of public domain were fenced illegally to try to maintain better control of the herds and to keep range-jumpers off.

The Green Mountain Stock Ranching Company, or the UF as its brand was know, was one of the first large cattle outfits to move into Armell's Creek around 1883 and exemplifies the economic ups and downs of the early stock raising industry. Its range lay between the Crow Reservation and the Rosebud. Although the home ranch was located on the south shore of the Yellowstone across from Great Porcupine Creek, many camps were scattered throughout the area, one on the present site of the Duncan McDonald place just northwest of Colstrip. The Green Mountain Company

was originally a cattle outfit financed mainly by Vermont money. The winter of 1886-87 proved that raising cattle in Montana was not a fool-proof way to make money, so the ranch was bought out by Fletcher Brothers. The sale was limited to stock, buildings, the brand, and the consent that other ranchers would not range-jump. It must be remembered that this was the open range; the land belonged to the government.

In the early 1890's horses came into great demand. The canning industry was using many thousands of head. South Africa's Boer War required many more. Newly arrived homesteaders needed stout work stock to pull farm equipment. So the Fletcher Brothers decided to raise horses. Fifty to sixty percheron, Belgian, and other work breed studs were purchased to breed to native Montana mares. For many years the enterprise worked well. Many thousand head were shipped in a single year, some as canners and some as green broke. But it was the honyocker who finally closed out the UF. The large number of homesteads filed in this area after 1910 made the range into a patchwork of fences and desert claims took the water. The UF finally moved over to Sunday Creek outside of Miles City.

Many stories could be told about the UF. One seems to demonstrate both the pride a cowboy had in his outfit and the resourcefulness of the early day merchant. A local saloon owner in Forsyth happened to buy an extremely bad batch of whiskey; so bad that nobody would drink it. In those days "red eye" was generally bought by the barrel and bottled in the basement. At any rate, this bar owner decided to get a few special bottles made, which he then filled with this rotten whiskey.

Next he advertised it as being so stout, not even a UF Cowboy could drink it. Naturally, the UF boys were flattered and everybody else had to prove they were just as tough. The owner peddled every bottle before he could even unpack his advertising signs. About half a dozen of those bottles with UF labeled in gold are still in existence. The cowboys, backed up by stories of this sort, were a special breed--glamorized and glorified--when actually they were hard-working, under paid, and led a rather lonely existence.

Sheep, like cattle, were first raised in western Montana by Catholic missionaries in the late 1850's. Merino sheep seem to be the first commercial breed introduced, and many cattlemen also kept sheep. Profits were good; wool was produced each year. Sheep also reproduced much faster, sometimes increasing 75% or better in one year. Wool could be shipped down river at little cost while cattle still had to be driven to market or railhead.

The sheep boom started in eastern Montana about the same time and for the same reasons as the cattle boom--the plains had been cleared of bison.and Indians, the railroads arrived, and there was all that free range. Because wool could be marketed with no loss of investment, much money was brought into the state and many large fortunes accumulated. Such well-known cattlemen as Poindexter, Orr, and Fergus also ran sheep. Ownership of 100,000 head was not uncommon.

Cattle moved into eastern Montana earlier, so generally, they had better range lands. But the woolies were hardy and could graze the Breaks and similar areas without too much difficulty. However, they

were never raised in any great numbers in the Armell's and Sarpy Creek areas. The popularity and prosperity of raising sheep in other areas of eastern Montana was indicated by the fact that in 1880 Montana had about a half a million sheep, and by 1901, there were over six million, more than six times the number of cattle. The hard winters, summer droughts, and crowded range conditions affected sheep less severely than cattle; and they were easier to tend, since one man and a good dog or two could handle about four bunches, 4,000 head. Clippings could be jobbed out so that shearers travelled the country much as threshing teams did in later years and combines do today. The sheep industry reached its peak later than the cattle industry, but it was maintained longer.

Many people would like to discount the role sheep have played in Montana's history or relegate the woolies to a lowly status. Sheep supposedly overgrazed the range; they cut up the sod with sharp hooves and made the land stink so that cattle could not follow. But the fact is that flocks were managed just as well or poorly as cattle herds. The problem was that open range was thought to be boundless with no limit placed on the number of animals it could support. Both sheepmen and cattlemen (and later the honyockers) believed this and, therefore, contributed to the depletion of the prairie resources.

Fortunes were made from sheep. In the 1890's Billings and Big Timber shipped more wool than any place in the western hemisphere. As homesteaders came and the sod was plowed under, sheep declined to under three million head. World War I increased the demand for wool and mutton temporarily, but like cattle, as the open range was enclosed, a way of life was ended and the boom died.

Agriculture started slowly in Montana. The 1870 census showed only 851 farms in the Territory, most of them located in western valleys where irrigation water was available. Good land had been available farther east, and there was little need for a hopeful, would-be farmer to settle so far from "the States" and in Indian country. Experience in North Dakota, Kansas, and elsewhere showed that farming west of the 100th meridian was marginal, so pilgrims were skeptical of trying to farm the Great Plains of Montana, part of the "Great American Desert." The completion of the railroads necessitated not only large amounts of crops and freight to be hauled but also the sale of the railroad lands in order for the railroads to prosper. Brochures boasting 20 or 40 bushels of wheat to the acre were circulated all over the East. Cheap government land and railroad lands were advertised. A poor man would be rich in a few short years! Land values were tripling yearly--so hurry up and come to Montana!

Changes in land laws and the addition of new laws helped Montana's agricultural outlook, also. However, the basic problem continued, for the land laws were written by legislators who had never been west of the Mississippi River. The first squatters in Montana filed for land under the Preemption Law of 1841. A person was allowed to buy 160 unsurveyed acres at $1.25 per acre. It was his after 18 months. The Homestead Act of 1862 lowered the financial requirements greatly. One hundred and sixty acres were given to anyone who would live on and work some of it for 5 years. A $25 filing fee was the only cash involved. Most of the Central Plains in Kansas, Nebraska, and the Dakotas was settled under this law.

It was soon evident, however, that 160 acres of Montana's dry plains was not enought to support a homesteader. Some river bottoms or acres where irrigation was possible were capable of producing sufficient crops to allow a family to remain. Most of the honyockers, however, had to rely on the fluctuating climate, and one bad year could break their marginal subsistance. As a result, different land laws were passed so that larger acreages could be held by one family with little or no cash out-lay. The Timber Culture Act in 1873 gave 40 acres to anyone who would plant 2½ acres of trees on it. The Desert Land Act of 1877 allowed one to file on 640 acres of land for 25 cents an acre and pay $1.00 per acre at the end of 3 years if the homesteader would build dams and ditches on it for irrigation. Several claims on the surveyed area were picked up this way. Both of these laws were abused. Trees were planted and not cared for and sometimes never even planted. Often the dams were built and ditches dug uphill, just to meet the letter of the law and gain title to the land or just use it for the specified length of time and then return it to the government. Ranchers would have each of their cowboys file on a homestead and then buy the land back for $1.00. Once in a while an enterprising cowboy would renege on a deal and charge the rancher $1,000 to buy it back. If the land had water or some other important asset, the plan would work.

The land law that probably contributed most to the eastern Montana farming boom was the 1909 Enlarged Homestead Act. Three hundred and twenty acres were allowed, but one-eighth had to be cultivated continuously. An amendment in 1912 reduced residence to 3 years and allowed 5 months

absence from the claim. This let a man work somewhere for cash and still prove up on his homestead. An arrangement probably used by the Caskey family for proving up their 320.

Between the changes in land laws and the advertising of the railroads, thousands of honyockers were induced to come to Montana. Many were store clerks, vagabonds, or black sheep from respectable families; but most were hard working people, hoping to find a good new life in the beautiful, rich, friendly land of Montana. They did work hard, and the 1920 census showed 37½% of Montana was being cultivated.

No one listened to John Wesley Powell (1879), the head of the U.S. Geological Survey. He wanted the arid plains to be homesteaded as mixed livestock and farming ranches of 4 square miles. A system which is in large use today. He stated that the frequent droughts would not allow continuous farming, but crops could be grown in most years. Hay and grain could be grown as cash crops and for winter feed. If this system of larger farms had been used, many honyockers would have been able to retain their homesteads. 1917 to 1919 was the first of Montana's twentieth century droughts. Yields per acre dropped from a 15 year average of 25 bushels of wheat to 2½ bushels. The crop loss in 1919 was $50,000,000. Six thousand now hopeless honyockers started to leave Montana and go back home. Farmers and ranchers who still had some capital or credit bought up the abandoned land for taxes. Although the twenties was a decade of above normal precipitation and prices were good, mortgage foreclosures on 11,000 farms put 2 million acres

out of crop production. The droughts and grasshoppers of the Thirties sent thousands more back East and closed Montana's homestead boom, leaving only the abandoned homesteads as evidence of a thirty year segment of western history.

Ethnographic Sketch

Southeastern Montana was inhabited by Kiowa, Arapaho, Flathead, Shoshone, and Crow Indians from about 1650 A.D. These groups dominated portions of the area at different times with the Crow eventually controlling the region by the beginning of the Historic Period. The Blackfoot, Cheyenne, Sioux, Pend d'Oreille, Assiniboine, and perhaps other peoples utilized the area as a temporary hunting ground.

The reconstructed movements of these nomadic peoples are complex. For example, in the middle of the 18th Century, the Crow separated from their semi-sedentary river dwelling parent group, the Hidatsa, perhaps in the vicinity of the Platte River. Some of the Crow bands apparently moved near the Little Missouri River only to be driven into the Yellowstone Valley by Shoshone, Cheyenne, and Arapaho (Clark, 1968). The Crow probably drove another group from the Yellowstone. Each push by one group and the resultant retreat of another pushed still another people. The Cheyenne may have pushed the Crow west but they were in turn driven south by the Sioux. The Cheyenne then drove the Kiowa south from the Platte River (Ibid.).

It is not known which peoples occupied southeastern Montana beyond the latter part of the Late Prehistoric. The peoples who roamed this region in the Early and Middle Prehistoric Periods may not have been the closest ancestors of the Indians who first encountered the white man on the Northwestern Plains. ???

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Procedures and Means Used to Identify Cultural Resources

Bureau Procedures

The Bureau relied heavily on two surface surveys in the identification of cultural resources (Fredlund, 1972a,; Fredlund and Fredlund, 1974). Also reviewed was a listing of archaeological sites in Rosebud County prepared by the University of Montana (Smith, 1974).

The National Register of Historic Places was reviewed. It currently lists no sites in Rosebud County, Montana. The Montana historic sites compendium in the Montana Historic Preservation Plan lists one site which may be near Colstrip, the Armells Creek Tepee Ring Site. The compendium states that the site is a group of eight ceremonial rings located 35 miles south of Forsyth. Archaeological surveys in the mining area have not located this site.

Non-Bureau Procedures

(From Fredlund, 1972b)

An archaeological survey can be defined simply as an inventory and field reconnaissance of a region's archaeological values. Initial phases of the present survey, involved seeking the respective landowners' permissions to survey the areas under investigation, discussing with them and questioning them about locally known archaeological sites, and frequently visiting the sites with them. These sites, though not necessarily in the survey lands proper, provide background information relevant to an understanding of the region's archaeology.

Actual field survey was conducted by systematically walking over all land surface designated by contract, and looking for signs of aboriginal usage. By covering the terrain in an organized pattern, all hills, flats, and ridges were investigated and searched for archaeological remains. All dry washes were walked, and their exposed cutbanks examined for subsurface archaeological sites that might have been exposed by erosion. All sites found were then numbered according to the Smithsonian system and recorded on Statewide Archaeological Survey forms. Photographs were taken, and if the site warranted further attention, it was tested and mapped.

(From Fredlund and Fredlund, 1974)

The archaeological field techniques used in any research project are, to a great extent, determined by the characteristics of the region where the project is located. Consequently, the techniques we selected are for the most part standard archaeological field survey techniques adapted for the northern plains. The following procedure was used, although not necessarily in the order stated:

1. Interview local landowners and artifact collectors.

2. Conduct intensive surface reconnaissance on the contracted lands. Our method of survey was to delimit one section of land at a time, the boundaries of which could be easily identified by the surveyors, and disperse the crew to systematically walk all of the area. In this way all washes, ridges, flats, and rock outcrops were checked for evidence of prehistoric and historic activity. All water sources were carefully examined.

3. Locate and record all sites. When a site (a location indicating past human activity) was located, it was recorded on standard site survey forms, given a name, and numbered by the Smithsonial trinomial numbering system, i.e., 24 RB 1040. Under this system, 24 is the state of Montana (the 24th state in alphabetical order), RB stands for Rosebud County, and 1040 is the specific site number. The name primarily acts as a mnemonic device for the researchers, names being easier to remember than numbers. Each surveyor carries a notebook and records any other facts about the sites or the land which he (or she) is traversing. Features or non-removeable objects, like vision quest structures, rock rings, and rock art, are recorded on special forms used for many of these features. Historic features such as homesteads are measured, described, drawn, mapped, and photographed as are the prehistoric sites when warranted.

4. Collection of artifact material. After the site was recorded, artifacts were collected which might give us more information on when the site was occupied or on the type of activity which might have been carried out at this location. Fire-burned rock from old hearths, bone fragments, and any other evidences of human activity were noted, photographed, and/or collected. In addition to picking up tools and any diagnostic artifacts, we conducted total pick-ups on 14 of the twenty-seven prehistoric sites recorded. We first divided the site into four quarters by establishing transecting lines oriented to the primary directions. We then collected all stone flakes and other cultural debris from the surface of each quarter of the site and kept each

collection separate for laboratory analysis. The sites which were not part of the total pick-up operation either had no recoverable debris to pick up or the lithics were too widely scattered to be able to control the locations of recovery. Various methods of total pick-up have been used by other archaeologists on survey, but this quarterly division seemed as accurate as we could justify and was not extremely time consuming. We found that these quadrant pick-ups were adequate and that we obtained far more information from our artifacts than we would have gained had we continued the standard method of recovering only tools or diagnostic artifacts.

5. Testing sites. All sites possessing subsurface evidence of prehistoric activity were tested for subsurface cultural deposits by digging a test pit one meter square. This pit was oriented north-south and excavated in arbitrary (generally) 5-10 cm units until bedrock or compacted sterile sand was encountered. Material recovered from these tests was then given laboratory analysis to see if further excavation was warranted. Rock shelters are always tested because, occasionally, buried cultural horizons are found when no evidence of human habitation is visible on the surface.

Procedures and Means Used to Evaluate Cultural Resources

In evaluating cultural resources, the Bureau applies the criteria established in E.O. 11593 for the nomination of sites the National Register of Historic Places. The Bureau evaluates each site against

additional criteria to determine research values, archaeological values, and historical values. The criteria include; scarcity of the resource, depth of fill, state of preservation, immanence of destruction, state of knowledge of the resource and similar resources, and the potential of the resource to contribute to the solution of special problems.

TYPES OF SITES

IN THE COLSTRIP AREA

(From Smith, 1974)

Habitation Occupation Surface lithics Lithic debris	Though these four terms are used as rough equivalents, there are distinctions which should be made. Habitation and occupation are interpretive terms, while Lithic material and lithic debris are descriptive.

Habitation implies that the site was used as a living site for an unspecified period of time, but longer than an overnight camp. Occupation, in point of fact, has little meaning, since occupation means no more than "someone was there" which is also implied in the fact that the site was recognized in the first place. Most any site which cannot be recognized as having a special use can be called an occupation.

Camp Occupation	Surface evidence of single or repeated short-term use are the most frequently recorded types of sites in Montana.

These may be found in any environmental zone and any altitude. Any site which might be attractive as a camping spot today is a potential archaeological site. Additionally, many are found at locations of now-extinct springs and other apparently unlikely locations. Camp-occupation sites are often marked only by a concentration of waste flakes; occasionally, one may find a complete or broken artifact, or

unmistakable evidence of a prepared fire area. Rarely, one might find a site which has not been previously found by a collector, in which diagnostic point types are present. A less obvious clue is the presence of lithic material which is non-native and could not have been transported by natural forces.

Petrograph sites (Pictographs) (Petroglyphs)	Petrograph is a collective term which includes pictographs (painted) and petroglyphs (incised, grooved) designs on rock surfaces.

These are most often found where suitable rock surfaces exist, on south-facing exposures along travel routes, in rock shelters and caves, on rock ledges and, less frequently, on boulders. Occasionally, rock art is found in less obvious spots such as narrow rugged canyons or near the tops of cliffs in virtually inaccessible locations.

At the present time, petrograph sites are not subject to reliable interpretation, though a rough chronology has been set up by Malouf. Because of forces of erosion and weathering, it is thought that most such sites are relatively recent. Meanings of the motifs are even more obscure, since different groups used rock "art" for different purposes. Often the people living in an area have only legends to account for the presence of pictographs, suggesting that they were executed by an earlier group.

For some inexplicable reason, many people cannot resist the temptation to "improve" upon aboriginal art; thus, many sites of high

esthetic value have been vandalized or irreparably damaged. Those which are still in good condition should be preserved and protected, both in their existing physical form, and on film. Hopefully, the effort will be made to record the best of these on infra-red which, properly exposed and developed, should bring out superpositions and heavily weathered motifs which are invisible or barely visible in natural light.

Lookouts Observations Vantage points	These terms are essentially equivalent, and refer to a vantage point from which one might observe movements of people or game.

They are necessarily located on a high spot, usually with a wide view. No structure was built, in most cases, and the fact that such a spot was visited by man is usually marked by the presence of chipping debris. Such a site is distinguished from a small camp by its location and the absence of any evidence of a structure or camping debris. Several such sites are known from the Colstrip Study Area.

DESCRIPTION OF ARCHAEOLOGICAL SITES IN MINING AREA "A"

(From Fredlund, 1972a)

Ellison Petroglyph Site (24RB1019). Site 24RB1019 is a rock art site located in Sec. 31, T. 2 N., R. 41 E. Four panels of petroglyphs (Figs. 2-5) have been drawn on the northeast vertical face of a stump-like, 25-30 ft high, eroded sandstone remnant that juts up at the end of a pine-covered ridge. Site 24RB1020, a habitation and lookout site, surrounds the art panels. The two sites, although adjacent, were assigned separate numbers because there is no way of ascertaining any direct association between the inhabitants of 24RB1020 and the individuals responsible for the art work at 24RB1019.

The four panels cover completely a flat, vertical sandstone face approximately 8 ft in height by 15 ft in width, but vary among themselves as to their individual dimensions and height above the present ground surface. Panel 1 covers an area approximately 4 ft by 2 ft (8 sq ft) and is 4 ft to 8 ft above the surface. Panel 2 is also 4 ft by 2 ft (8 sq ft), but covers an area from 3 ft to 7 ft above the surface. Panel 3 is smaller, being only 2 ft by 2ft (4 sq ft), and is at a height of from 4 ft to 8 ft above the ground. Panel 4 is 2½ ft by 1 ft, and is the lowest of the panels, being at a height of only 0 (surface) to 1½ ft. In addition, one large sandstone boulder, which had fallen face-down from the sandstone wall within the past 10 years, was reported to have exhibited numerous figures. It was impossible to move the boulder in order to verify the lead, but it seem reasonable that the report is valid.

Many motifs are still clearly visible on the panels, despite damage due to weathering. Based on the superimposition of some of the figures and on the various art elements present, it seems very likely that more than one group of people were responsible for this art work. Grooves, lines, and various human and animal figures have been etched and rubbed into the soft sandstone.

Art styles frequently found throughout the Northern Plains occur in Panels 1-3, as follows: 7 shield-bearing warriors; 3 V-necked anthropomorphs; 2 solid body, square-shouldered anthropomorphs; 3 outlined, square-shouldered anthropomorphs; 2 horses with feathered arrows in their backs; 1 tipi; and numerous lines and arrows.

Superimposition occurs on all three panels, but the following should be noted especially: the lines dissecting the V-necked, outlined shield bearer and the square-shouldered anthropomorph in Panel 1 are etched over the figures; the V-shouldered anthropomorph occurs over an incomplete circular design on Panel 2; and a V-shouldered figure is superimposed on a square-shouldered figure in Panel 3.

Art elements similar to those in Panels 1-3 occur at the following sites, as noted by Conner and Conner (1971:17):

Pictograph Cave, pictographs (Mulloy, 1958)
Pryor Creek, No. 2, pictographs
Bear Gulch, pictographs (Secrist, 1960)
Atherton Canyon, pictographs (Secrist, 1960)
Decker Site, petroglyphs
Deer Medicine Rocks, petroglyphs
Nordstrom-Bowen, petroglyphs (Hagen, 1963)
Langman Petroglyphs, petroglyphs

In addition, several other sites in the area of Colstrip display these art forms, especially 24RB1027, the Benjamine Hill site, located near the Western Energy survey area on Rosebud Creek.

While the elements on Panels 1, 2, and 3 are fairly common in the Northern Plains, Panel 4 is atypical. The style present is, to my knowledge, not reported from any other site in the state. The art work on Panel 4 (Fig. 5) consists of frequently connecting curved lines, and rotund heads with short "crew-cut"-like hair and smiling faces. The low height of this panel above the present ground surface (1½ ft) and the advanced stage of its decomposition suggest that is was the work of a different and earlier group of people than those who were responsible for Panels 1-3. A test pit was excavated below this panel; however, fallen sandstone blocks have sealed off any information which might be gained from the site (see 24RB1020 for the test report).

Ellison Rock Site (24RB1020). Site 24RB1020 is a habitation site which extends 100 yds upslope and away from the sandstone remnant exhibiting the petroglyphs of 24RB1019. The site also includes a high sandstone remnant which had been used prehistorically as a lookout site.

The ridge is covered by native grasses, prickly pear, sage, and sparse ponderosa pines. Various types of brush grow along the bottom of an adjacent dry wash which contains water for at least part of the year.

Three artifacts were found on the surface of the site: a small side-notched projectile point, and two granite-tempered, dark gray

plain ware pottery sherds. A small test pit was dug at the base of the sandstone remnant under the rock art panels. The top level of the revealed strata was 2-6 in deep and consisted of dry, wind-blown sand and surface duff. Below this stratum was a stratum of gray sand which extended to bedrock, at a depth of 19 in below the surface. The sand stratum was composed of compacted sandy soil and sandstone fragments with scattered charcoal, and evidenced much rodent activity. From the test pit were recovered one projectile point, three scrapers, and the remnants of a hearth.

The projectile point is a small side-notched type, 2.6 cm long by 1.2 cm wide by 0.3 cm thick. One of the blade edges is straight, the other convex. Of the three scrapers, two are flake scrapers, both exhibiting fine pressure retouch on one edge only. One scraper is a plano convex end-scraper of tan chalcedony. This scraper is very well made and exhibits controlled primary percussion scars on the dorsal surface. Pressure retouch is evident along the lateral edges and nose of the scraper. Part of one hearth made of fragmented sandstone rock was found resting on the sandstone bedrock. It did not contain sufficient carbon for radio-carbon dating.

Farley Ridge Site (24RB1022). Site 24RB1022 is located along the base of a low sandstone outcrop ridge that extends into a basin. Small concentrations of debitage are found intermittently from the base of the sandstone ridge to its junction with the higher pine-covered ridges.

It is possible that because the ridge provided concealment, it was used as an approach route to game animals grazing on the flats.

Western Energy Shelter (24RB1033). Site 24RB1033 is located in Sec. 32, R. 41 E., T. 2 N. The shelter faces southward and is slightly above the floor of the east-west extending dry wash that dissects Sec. 32. Ponderosa pine, chokecherry, and native grasses constitute the vegetation of the immediate site surroundings.

Debris from lithic tool manufacture was found on a low sandstone outcrop directly above the rock shelter. Because of the proximity of the debitage, it was felt necessary to test the shelter for subsurface cultural material. The shelter was excavated to a depth of 49 in below surface at which point bedrock was encountered. The subsurface strata consisted of sand deposited by wind and water, and rock sloughed from the shelter's ceiling.

At a depth of 5 in below the surface was encountered a fragmented wood floor composed of 2-in thick, sawed planking, some of which still evidenced green paint. Other historic items recovered included a metal can, glass, and cloth fabric found at 11 in below the surface. A concentration of charcoal at about 12 in below the surface suggests that part of the wood structure had burned.

APPENDIX 3

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

NO ACTION ALTERNATIVE

2. Stages of implementation

MINING

Short Term/Long Term

+ Favorable
- Adverse
H,M,L High, Moderate or Low Magnitude
O No Impact
X Unknown impact

	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS: Removal & Stock-piling topsoil	Overburden Removal	Blasting & excavation of coal	Transportation, delivery & crushing		6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air movement patterns	-/-	-/-L	O	O		
	Temperature	-L/-L	O	O	O		
	Particulate Matter	-/-	-/-	-/-	-L/-L		
	Harmful or Toxic Gasses	-/-	-/-	-/-	-/-		Exhaust emissions
	B. LAND						
	Soil depth	+H/-H	O	O	O		
	Soil Structure	+H/-H	O	O	O		
	Soil Nutrient Properties	+H/-H	O	O	O		
	Soil Pollutant Properties	O	O	O	-/-		
	Soil Erosion	-/-	O	O	O		
	Geologic Structure	O	+H/-H	+H/-H	O		
	Topography	-/-	-H/-H	O	O		
	Land Use Compatibility	+M/-L	-/-L	+H/-H	+H/-H		
	Land Use Suitability	+M/+M	+M/+M	+			
	C. WATER						
	Hydrologic Cycle	+L/-L	-/-L	+/-L	O		
	Sediment Load	+M/-M	-/-	O	O		
	Dissolved Solids	X/X	X/-L	O	O		
	Chemicals, Heavy Metals, Toxics	X/X	X/X	O	O		
	Nutrients	X/X	-/-	O	O		
	Acid Balance	O	O	O	O		
	Dissolved Oxygen	-/-	O	O	O		
	Temperature	-/-	O	O	O		
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	Vascular Plants	-/-	O	O	O		
	Phytoplankton	-/-	O	O	O		
	Floating	O	O	O	O		

(Continued on reverse)

DISCRETE OPERATIONS	Removal & stock-piling topsoil	Overburden Removal	Blasting, excavation & removal of coal	Transportation, Delivery & Crushing	Cumulative impacts of all actions*	
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)						
B. PLANTS *(Terrestrial)*						
Lichens & Mosses	~~L~~/-M	-/-	O	O		
Grasses & Forbs	~~M~~/-H	-/-	O	O		
Shrubs	~~M~~/-H	-/-	O	O		
Conifers	~~M~~/-H	-/-	O	O		
Broadleaf trees	~~-~~/-L	-/-	O	O		
C. ANIMALS *(Aquatic)*						
Mammals	-/-L	O	O	O		
Birds	-/L	O	O	O		
Amphibians & Reptiles	-/L	O	O	O		
Fish	X/X	O	O	O		
Invertebrates	-/L	O	O	O		
Zooplankton	-/L	O	O	O		
D. ANIMALS *(Terrestrial)*						
Mammals	~~H~~/-H	-/-	O	-/-		
Birds	~~H~~/-H	-/-	O	-/-		
Reptiles	~~H~~/-H	-/-	O	-/-		
Invertebrates	~~H~~/-H	-/-	O	-/-		
Man	-/-	-/-	-/-	-/-		
III. INTERRE-LATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession	~~-~~H/-M	-/-	O	O		
Food Relationships	~~-~~H/-M	-/-	O	O		
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Aesthetic Values					~~-~~H/-H	
B. SOCIOCULTURAL INTERESTS						
Educational-Scientific	+/+	+/+	+/+	+/+		
Cultural Resources	~~-~~M/-L	O	X/X	O		
Recreation					~~-~~L/-L	
Social Welfare-Economics					M/-L	
Attitudes & Expectations					O/-M	
Local Regulatory Structure					O	

* Used where individual discrete operations are impossible or impracticable to analyze separately

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.
2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.
3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.
4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (-) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

PROPOSED LEASE MODIFICATION (ADD 320 ACRES)

2. Stages of implementation

MINING

3. DISCRETE OPERATIONS		Removal & stock-piling topsoil	Overburden Removal	Blasting & excavation & loading coal	Transportation, delivery & crushing		
4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air movement Patterns	-/-	-/-	O	O		
	Temperature	-/-	O	O	O		
	Particulate Matter	-/-	-/-	-/-	-L/-L		
	Harmful or Toxic Gasses	-/-	-/-	-/-	-/-		Exhaust Emissions
	B. LAND						
	Soil Depth	-/-L	O	O	O		
	Soil Structure	-/-	O	O	O		
	Soil Nutrient Properties	-/-	O	O	O		
	Soil Pollutant Properties	O	O	O	-/-		
	Soil Erosion	-/-	O	O	O		
	Geologic Structure	O	-H/-H	-H/-H	O		
	Topography	O	-H/-H	O	O		
	Land Use Compatibility	+H/+H	+L/+M	+H/+H	+H/+H		
	Land Use Suitability	+H/+H	+H/+H	+H/+H	+H/+H		
	C. WATER						
	Hydrologic Cycle	-/-	-/-	-/-	O		
	Sediment Load	+L/-L	-/-	O	O		
	Dissolved Solids	X/X	X/-	O	O		
	Chemicals, Heavy Metals, Toxics	X/X	X/X	O	O		
	Nutrients	X/X	-/-	O	O		
	Acid balance	O	O	O	O		
	Dissolved Oxygen	-/-	O	O	O		
	Temperature	-/-	O	O	O		
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	Vascular Plants	O	O	O	O		
	Phytoplankton	O	O	O	O		
	Floating	O	O	O	O		

(Continued on reverse)

	DISCRETE OPERATIONS	Removal & stock-piling topsoil	Overburden Removal	Blasting	Excavation Loading of coal	Transportation, delivery, & crushing	Cumulative impacts of all actions*	
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS						REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS (*Terrestrial*)							
	Lichens & Mosses	-/-L	-/-	O	O			
	Grasses & Forbs	+M/-H	-/-	O	O			
	Shrubs	+M/-H	-/-	O	O			
	Conifers	+M/-H	-/-	O	O			
	Broadleaf Trees	-/-	-/-	O	O			
	C. ANIMALS (*Aquatic*)							
	Mammals	O	O	O	O			
	Birds	O	O	O	O			
	Amphibians & Reptiles	O	O	O	O			
	Fish	O	O	O	O			
	Invertebrates	O	O	O	O			
	Zooplankton	O	O	O	O			
	D. ANIMALS (*Terrestrial*)							
	Mammals	+L/-L	-/-	O	-/-			
	Birds	+L/-L	-/-	O	-/-			
	Reptiles	+L/-L	-/-	O	-/-			
	Invertebrates	+L/-L	-/-	O	-/-			
	Man	-/-	-/-	-/-	-/-			
III. INTERRE-LATIONSHIPS	A. ECOLOGICAL PROCESSES							
	Succession	+H/-M	-/-	O	O			
	Food Relationships	+H/-M	-/-	O	O			
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER							
	Aesthetic Values					+H/-H		
	B. SOCIOCULTURAL INTERESTS							
	Educational-Scientific	+/+	+/+	+/+	+/+			
	Cultural Resources	+M/-L	O	X/X	O			
	Recreation					-/-		
	Social Welfare-Economics					M/-L		
	Attitudes & Expectations					O/-M		
	Local Regulatory Structure					O		

* Used where analysis of individual discrete operations are impossible or impracticable.

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.
2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.
3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.
4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (-) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. *Remarks* – Enter clarifying information.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

NO ACTION AND PROPOSED ACTION

2. Stages of implementation

RECLAMATION

3. DISCRETE OPERATIONS		Regrading Spoils	Topsoil Replacement	Revegetation			
4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air Movement Patterns	+/+	O	O			
	Temperature	O	O	+L/+L			
	Particulate Matter	-L/-L	-/-	+M/+M			
	Harmful or Toxic Gasses	-/-	-/-	-/-			Exhaust emissions
	B. LAND						
	Soil Depth	O	+H/+H	O			
	Soil Structure	O	-L/-L	+/+			
	Soil Nutrient Properties	O	-L/-L	+H/+H			
	Soil Pollutants Properties	O	O	O			
	Soil Erosion	+H/+H	+L/+L	+H/+H			
	Geologic Structure	O	O	O			
	Topography	+H/+H	+/+	+/+			
	Land Use Compatibility	+H/+H	+H/+H	+H/+H			
	Land Use Suitability	+M/+M	+M/+M	+M/+M			
	C. WATER						
	Hydrologic Cycle	+H/+H	+L/+M	+H/+H			
	Sediment Load	-/+L	-M/O	+H/+H			
	Dissolved Solids	-L/+L	O	O			
	Chemicals, Heavy Metals, Toxics	X/X	O	O			
	Nutrients	O	O	O			
	Acid Balance	O	O	O			
	Dissolved Oxygen	-/O	O	+/+			
	Temperature	-/O	O	+/+			
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	Vascular Plants	+/+	+/+	O			
	Phytoplankton	+/+	+/+	O			
	Floating	O	O	O			

(Continued on reverse)

DISCRETE OPERATIONS	Regrading Spoils	Topsoil Replacement Revegetation	Cumulative Impacts*			* Used when analysis of individual discrete operations is impossible or impracticable
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)						
B. PLANTS *(Terrestrial)*						
Lichens & Mosses	X/X	X/X	X/X			
Grasses & Forbs	~~+/~~+L	~~+H/~~+H	~~+H/~~+H			
Shrubs	-/-	~~+H/~~+H	~~+M/~~+M			
Conifers	X/X	~~+H/~~+H	~~+M/~~+M			
Broadleaf Trees	X/X	~~+H/~~+H	~~+L/~~+L			
C. ANIMALS *(Aquatic)*						
Mammals	+/+	+/+	+/+			
Birds	+/+	+/+	+/+			
Amphibians & Reptiles	+/+	+/+	+/+			
Fish	O	O	O			
Invertebrates	+/+	+/+	+/+			
Zooplankton	+/+	+/+	+/+			
D. ANIMALS *(Terrestrial)*						
Mammals	+/+	~~+L/~~+L	~~+H/~~+H			
Birds	+/+	~~+L/~~+L	~~+H/~~+H			
Reptiles	+/+	~~+L/~~+L	~~+H/~~+H			
Invertebrates	+/+	~~+M/~~+M	~~+H/~~+H			
Man	-/-	-/-	~~-/~~ +			Some beneficial, some adverse impacts on men.
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession	~~+L/~~+L	~~+M/~~+M	~~+H/~~+H			
Food Relationships	~~+L/~~+L	~~+H/~~+H	~~+H/~~+H			
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Aesthetic Values				~~+N/~~+M		
B. SOCIOCULTURAL INTERESTS						
Educational-Scientific				X/+H		
Cultural Resources				O		
Recreation				+/+		
Social Welfare-Economics				+/+		
Attitudes & Expectations				~~+H/~~+H		
Local Regulatory Structures				O		

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.
2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.
3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.
4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (–) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (–) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. *Remarks* – Enter clarifying information.

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ANALYSIS OF IMPACTS - ELU's

In an attempt to reflect the significance of the changes in the environment following mining, each of the natural ELU's within Area A was rated by basic components of the environment. The rating in Table 1 was done by the analysis team. The ELU components were rated from zero to three depending on relative value to that ELU. Zero represents no value and three represents the highest. All component ratings were totaled, thus establishing an arbitrary Base Level Value for each ELU.

Table 1

BASE LEVEL VALUES

	Air	Soils	Water	Plants	Animals	Economic ← HUMAN VALUES →	Non-Economic	Base Level Value
MBT-SS	2	2	2	3	3	2	3	17
MBSS-SS	2	1	1	1	3	0	2	10
MBSS-XF	2	1	2	1	3	0	2	11
MSB	2	0	1	0	2	0	3	8
DMS-SG	2	2	2	2	2	2	2	14
DMS-SS	2	2	2	2	2	2	2	14
DMS-XF	2	2	3	2	2	2	2	15
DMS-C	2	2	2	2	2	2	1	13
A/T-SG	2	3	3	2	2	3	2	17
A/T-SS	2	3	3	2	2	3	2	17
A/T-C	2	3	3	2	2	3	1	16
CFP-MF	2	3	3	2	3	2	1	16
	24	24	27	21	28	21	23	

Table 2 reflects the relative change in each ELU with mining and reclamation. With each step in mining the value destroyed was subtracted from the Base Land Value. The numerical value subtracted is modified by the area of that ELU which would be mined. In reclamation, the replaced values were numerically added. The total after reclamation was compared with the Base Level Value. The Residual Difference shows the total resource difference between the reclaimed and natural ELU's. This comparison is subjective and arbitrary, but it suggests the difference between pre-mining and post-reclamation activities. It demonstrates numerically that reclamation cannot restore all resource values.

Table 2

RESIDUAL DIFFERENCE

	MBT-SS	MBSS-SS	MBSS-XF	MSB	DMS-SG	DMS-SS	DMS-XF	DMS-C	A/T-SG	A/T-SS	A/T-C	CFP-MF
Base Level Value	17	10	11	8	14	14	15	13	17	17	16	16
Topsoil Removal	unmined type	-1	-1	0	-9	-9	-10	-9	unmined type	-2	-10	unmined type
Overburden Removal		-1	-1	8	-2	-2	-2	-2		-1	-3	
Blasting and Excavation		0	0	0	0	0	0	0		0	0	
Transportation & Crushing		0	0	0	0	0	0	0		0	0	
TOTAL	17	8	9	0	3	3	3	2	17	14	3	16
Regrading	unmined	0	0	0	+3	+3	+3	+3	unmined	+1	+2	unmined
Topsoiling		0	0	0	+4	+4	+4	+4		+1	+5	
Revegetation		0	0	0	+2	+1	+1	+4		0	+6	
TOTAL	17	8	9	0	12	11	11	13	17	16	16	16
Residual Difference (±)	0	-2	-2	-8	-2	-3	-4	0	0	-1	0	0

ANALYSIS OF IMPACTS

Visual Contrast Ratings

The following is a description of the procedures followed in determining visual contrast ratings. These ratings were used as the primary basis for determining the magnitude of the impact on aesthetic values.

The degree to which a management activity adversely impacts the visual quality of the landscape depends upon the amount of visual contrast that is created between the activity and the existing landscape character. The amount of contrast between a proposed activity and the existing landscape character can be measured by separating the landscape into its major features (land and water surface, vegetation, and structures), and then predicting the magnitude of change in contrast of each of the basic elements (form, line, color, and texture) to each of the features. Application of the contrast rating system should be done from the most critical view point or points that are or will be commonly in use. When applying the rating system, keep in mind the following variables are the factors which determine how well the contrast is seen:

- Distance from which the project will be viewed.
- Angle of observation. The apparent size of a management activity is directly related to the angle between the viewers line-of-sight

and the slope being viewed. As this angle nears 90°, the maximum area is viewable and becomes most critical.

- Length of time the project is in view. If the viewer has only a brief glimpse of the project, the contrast can almost be disregarded. If, however, the project is subject to view for a long period, as from an overlook, the opportunity to detect contrast becomes very critical.
- Relative size or scale of the project in relation to its surroundings.
- Season of the year and the effects of seasonal changes. Contrast rating should be done considering the heavy or most critical use season.
- Light and how it will affect the project being viewed.
- The affect time has on the healing process. Few projects can be expected to meet the visual classes immediately upon completion. With some long-term projects, such as a strip mine, it may be desirable to have both short-term (5-years) and long-term objectives (completion of the project).

Contrast ratings quickly point out the elements and the features that will cause the greatest visual impact. This provides a guide to the most effective method of reducing the visual impact of a proposed activity or project. Those elements with the highest degree of contrast are the ones that can be attacked and lowered most effectively.

To determine the degree of contrast for vegetation or landform modification, compare the existing vegetation to the proposed modification of vegetation and the existing landform to the proposed modification

of landform. For structures, compare the existing landscape (landform, vegetation, and structures) to the proposed structure modification or addition on the landscape.

The visual contrast created by a management activity can be measured by determining the contrast caused by that activity in each of the basic elements. The ease of detecting contrast in the basic elements varies on a scale from 4 (form) to 1 (texture). By assigning values that indicate degree of contrast, 3 for strong, 2 for moderate, and 1 for weak, we can set up a direct multiplier for an indication of the strength of the contrast.

A total score for each feature of 1-10 indicates the contrast can be seen, but does not attract attention; 11-20 attracts attention--the contrast begins to dominate the characteristic landscape; 21-30 demands attention, will not be overlooked.

Tables 3 through 5 contain the contrast ratings for mining, reclamation, and final result respectively. Table 3 contrasts mining with the existing situation; Table 4 reclamation with mined area; and Table 5 reclaimed land with existing situation.

Table 3

Contrast Ratings for Mining VS. Existing Situation

	Element		Contrast	Score	Maximum Score Possible
Land Surface Elements	Form-4	X	Moderate - 2 =	8	12
	Line-3	X	Strong - 3 =	9	9
	Color-2	X	Moderate - 2 =	4	6
	Texture-1	X	Strong - 3 =	3	3
			Subtotal	24	30
Vegetation Features	Form-4	X	None - 0 =	0	12
	Line-3	X	Strong - 3 =	9	9
	Color-2	X	Strong - 3 =	6	6
	Texture-1	X	Strong - 3 =	3	3
			Subtotal	18	30
			Total	42	60

Table 4

Reclamation VS. Mined Land

	Element		Contrast		Score	Maximum Score Possible
Land Surface Features	Form-4	X	Strong	- 3 =	12	12
	Line-3	X	Strong	- 3 =	9	9
	Color-2	X	None	- 0 =	0	6
	Texture-1	X	Weak	- 1 =	1	3
			Subtotal		22	30
Vegetation Features	Form-4	X	None	- 0 =	0	12
	Line-3	X	Weak	- 1 =	3	9
	Color-2	X	Moderate	- 2 =	4	6
	Texture-1	X	Weak	- 1 =	1	3
			Subtotal		8	30
			Total		30	60

Table 5

Entire Area "A" After Reclamation VS. Existing Situation

	Element		Contrast	Score	Maximum Possible Score
Land Surface Features	Form-4	X	Moderate	- 2 = 8	12
	Line-3	X	Weak	- 1 = 3	9
	Color-2	X	Weak	- 1 = 2	6
	Texture-1	X	Strong	- 3 = 3	3
			Subtotal	16	30
Vegetation Features	Form-4	X	None	- 0 = 0	12
	Line-3	X	Moderate	- 2 = 6	9
	Color-2	X	Moderate	- 2 = 4	6
	Texture-1	X	Strong	- 3 = 3	3
			Subtotal	13	30
			Total	29	60

APPENDIX 4

PUBLIC INVOLVEMENT

In late December, 1975, the BLM Miles City District Office, sent a public interest solicitation letter and questionnaire to potentially concerned persons, groups, and agencies of the subject coal lease modification (see pages 3 and 4 of this appendix). The mailing list for this letter included 78 entities with potentially valuable input and comment regarding this federal action (see pages 5 through 11 of this appendix). Replys were received from 32 of the 78 solicitations for a response level of 41%.

For the purpose of response analysis, the solicitations and respondents were divided into eight arbitrary categories as follows:

		No. of Solicitations	No. of Responses
1.	Governmental Agencies (GA) (Local, State, & Federal)	25	13
2.	Local Landowners (LL) (Colstrip Vicinity)	19	7
3.	Environmental Concerns (EC)	14	4
4.	Energy Industry (EI)	7	3
5.	Agricultural Industry (AI)	7	2
6.	Political Alignments (PA)	3	1
7.	Academic Concerns (AC)	2	2
8.	Business - Commerce (BC)	1	0
	TOTAL	78	32

The majority of respondents (29 of 32) indicated a desire to receive a copy of the environmental analysis, and 25 of 32 indicated they would comment on it, if appropriate.

Responses to items three and four of the questionnaire were combined and tabulated by interest element and respondent category. Most definitive responses dealt with legal and administrative topics. Water use problems and quality were the next most common interest element in the responses.

It was felt that a good cross-section of interest groups, industry, and land owners was reached by the letter and questionnaire.

IN REPLY REFER TO

1791

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
P.O. Box 940
Miles City, Montana 59301

December 31, 1975

The Bureau of Land Management has received an application for modification of an existing coal lease held by Western Energy Company. The application requests the lease of an additional 320 acres in the E½ of Section 32, T. 2 N., R. 41 E., P.M.M. The coal is located in Western Energy's "Area A" at Colstrip, Montana.

In compliance with the National Environmental Policy Act of 1969 the Bureau will be preparing an Environmental Analysis of the proposed modification. In order to facilitate public input into this analysis, it is requested that the attached questionnaire be completed and returned by interested persons. The form should be returned to, District Manager, Miles City District, Bureau of Land Management, Box 940, Miles City, Montana 59301, Attention: Environmental Coordinator. It is requested that responses be sent so that they be received in this office no later than January 23, 1976.

Sincerely yours,
/s/ Roger R. Brubaker

Acting District Manager

Attachment

Appendix 4

Exhibit 1

Name _____

Organization _____

Address _____
City State Zip

1. Would you desire a copy of the Western Energy coal lease modification environmental analysis? _____

2. If furnished with a copy of the analysis, would you comment on it, and provide the BLM with your comments? _____

3. If familiar with the location of the proposed action, is there any area of impact that you are aware of, that deserves special consideration in the analysis?

_____

_____

_____

4. Is there any information that you feel should be brought to the BLM's attention that would facilitate the preparation of an analysis on the proposed action?

_____

_____

_____

_____

_____

Appendix 4

Exhibit 1

TABLE 1

Western Energy Coal Lease Modification (1975) -
Billings #020989-038770
Initial Interest Mailing List

Rosebud County Planning Board
c/o Don Holland - Chairman (GA)
Forsyth, Montana 59327

U.S.D.A. - Soil Conservation Service
121 North 11th Avenue (GA)
Forsyth, Montana 59327

Rosebud County Commissioners
Forsyth, Montana 59327 (GA)

County Extension Agent
Rosebud County (GA)
Forsyth, Montana 59327

Administrator - Environmental Sciences Division
Montana State Dept. of Health and Environmental Science (GA)
Cogswell Bldg.
Helena, Montana 59601

Director
Montana State Department of Natural Resources (GA)
and Conservation
32 South Ewing
Helena, Montana 59601

Director
Montana Dept. of Fish and Game (GA)
Sam W. Mitchell Bldg.
Helena, MT 59601

Director
Montana Historical Society (GA)
225 North Roberts
Helena, MT 59601

Commission on Local Government
Montana Governor's Office (GA)
Room 348 State Capitol
Helena, MT 59601

Federal-State Coordinator
Montana Governor's Office (GA)
1424 Ninth Avenue
Helena, MT 59601

Project Director
Old West Commission (GA)
1424 Ninth Avenue
Helena, Montana 59601

Chief - State Land Use Planning Bureau
Montana State Dept. of Intergovernmental Relations (GA)
1424 Ninth Avenue
Helena, MT 59601

Commissioner
Montana Dept. of State Lands (GA)
1625 Eleventh Avenue
Helena, MT 59601

Executive Director
Montana Environmental Quality Council (GA)
1228 Eleventh Avenue
Helena, Montana 59601

Chairman
Montana Energy Advisory Council (GA)
Room 104 - State Capitol
Helena, Montana 59601

Public Service Commission
Montana Dept. of Public Service Regulation (GA)
1227 Eleventh Avenue
Helena, MT 59601

U.S.D.A. - Forest Service
Supervisor - Custer National Forest (GA)
2502 - 1st Avenue North
Billings, Montana 59103

U.S.D.I. - Fish and Wildlife Service
Central Park Building (GA)
711 Central Avenue
Billings, Montana 59102

U.S.D.I. - Geological Survey
Conservation Division (GA)
Room 217, Post Office Building
2602 1st Avenue North
Billings, Montana 59101

U.S.D.I. - Geological Survey
Water Resources Division (GA)
3 N - 7th St. West
Billings, Montana 59101

U.S.D.I. - Bureau of Indian Affairs
c/o Mr. James F. Canan (GA)
4th Floor, Federal Bldg.
316 North 26th Street
Billings, Montana 59101

U.S.D.I. - Bureau of Mines
Billings Office (GA)
Room 2228, Federal Bldg.
316 North 26th Street
Billings, Montana 59101

U.S.D.I. - Bureau of Reclamation
Director - Upper Missouri Regional Office (GA)
Room 2051, Federal Bldg.
316 North 26th Street
Billings, Montana 59101

Montana Geological Society
P.O. Box 844 (EI)
Billings, Montana 59101

Mr. Carl Anderson
The Montana Power Company (EI)
Electric Building
Butte, Montana 59701

Center for the Public Interest, Inc.
c/o Mr. Rick Applegate (EC)
P.O. Box 931
Bozeman, Montana 59715

Montana Snowmobile Association
c/o Mrs. Nina Smith (EC)
410 North 18th
Bozeman, Montana 59715

Nature and Wildlife Society
P.O. Box 2861 (EC)
Great Falls, Montana 59401

Dr. Wilson Clark
Environmental Communications Council (EC)
Eastern Montana College
Billings, Montana 59101

Mr. Reg Davies
Montana Stockgrowers Assoc. (AI)
Chinook, Montana 59523

Mr. S. L. Groff
Montana Bureau of Mines and Geology (GA)
Butte, Montana 59701

Mr. Grant W. Buswell
Water Resources Division (GA)
Sam Mitchell Bldg.
Helena, MT 59601

Montana Wildlife Federation
c/o Gay Easton (EC)
519 2nd Ave.
Laurel, Montana 59044

Sierra Club, Montana Group
c/o Mrs. Jane Calcaterra (EC)
Box 315
Missoula, Montana 59801

Audubon Society
c/o Sid Martin (EC)
1110 Wilder
Helena, MT 59601

Geologist
c/o Charles Linberg (EI)
Resource Development Department
Burlington Northern
176 E. 5th Street
St. Paul, Minnesota 55101

Montana Chamber of Commerce
P.O. Box 1730 (BC)
Helena, Montana 59601

Montana Geophysical Society
2546 Wyoming Avenue (EI)
Billings, Montana 59102

Montana Beef Council
c/o Robin MacNab (AI)
7 Edwards Street
Helena, Montana 59601

Eldon Smith
2311 Highland Court (EC)
Bozeman, MT 59715

Montana State University
Dept. of Sociology and Anthropology (AC)
Bozeman, MT 59715

University of Montana
Department of Anthropology (AC)
Missoula, Montana 59801

Mrs. Anne Charter
1115 Burlington Avenue (EC)
Billings, Montana 59102

Northern Plains Resource Council
421 Stapleton Building (EC)
Billings, MT 59101

Western Energy Company
40 East Broadway (EI)
Butte, MT 59701

Carolyn Alderson
Bones Brothers Ranch (EC)
Birney, Montana 59012

Pat Warren, Chairman
Committee of Rural Development (AI)
Forsyth, MT 59327

Bill Gillin
Farm Bureau (AI)
Forsyth, MT 59327

Joe M. Nansel, Chairman
Rosebud County Conservation District (AI)
Forsyth, MT 59327

Don Bailey
Rosebud Protective Association (AI)
Forsyth, MT 59327

Montana Woolgrowers Assoc.
P.O. Box 1693 (AI)
Helena, MT 59601

Rosebud-Treasure Wildlife Assoc.
c/o Mrs. Lynn Eggert (EC)
Big Horn, MT 59010

League of Women's Voters
c/o Grace Edwards (PA)
140 South Crestwood
Billings, MT 59102

Ecological Consulting Service Airport Way Bldg. West 1300 Block Cedar Street Helena, MT 59601	(EC)
Olson-Elliott Assos. 349 Last Chance Gulch P.O. Box 1209 Helena, Montana 59601	(EC)
Chairman - Tribal Council Northern Cheyenne Indian Tribe Lame Deer, Montana 59043	(PA)
Mr. Gene Tuma Mayor of Forsyth Forsyth, Montana 59327	(PA)
Mr. Nolan Fandrich Colstrip Montana 59323	(EI)
Mr. Martin White Colstrip Montana 59323	(EI)
Ashenhurst Ranch Gene Ashenhurst Forsyth, MT 59327	(LL)
James N. Bailey Forsyth Montana 59327	(LL)
John L. Bailey Forsyth, MT 59327	(LL)
William Broadus, Jr. Forsyth, MT 59327	(LL)
Joe W. and Helen E. Curran Forsyth, MT 59327	(LL)
George Davidson Rosebud. MT 59347	(LL)
Mary Genie Dowlin Forsyth, MT 59327	(LL)
George Fahdl Colstrip, MT 59323	(LL)

Egan Ranch Inc.
Forsyth, MT 59327 (LL)

Joe W. Egan
Forsyth, MT 59327 (LL)

A. L. Farley
Forsyth, MT 59327 (LL)

Genie Philbrick Fulmer
Forsyth, MT 59327 (LL)

William F. Gillin
Forsyth, MT 59327 (LL)

Golder Ranch Inc.
Forsyth, MT 59327 (LL)

Greenleaf L & L Co.
Forsyth, MT 59327 (LL)

Donald C. Snider
Colstrip, MT 59323 (LL)

J. R. & Mariellen Lee
Forsyth State Bank (LL)
Forsyth, MT 59327

Mrs. Janet MacDonald
Forsyth (LL)
Montana 59327

Rocker Six Cattle Co.
Forsyth (LL)
Montana 59327

SYNOPSIS OF PUBLIC RESPONSE TO LETTER OF INTEREST

Interest 1/ Element	Government 2/ Agency	Energy Industry	Environmental Concerns	Agricultural Industry	Academic Concerns	Local Landowners	Political Alignments	TOTAL
Air	1		1			2		4
Land	1							1
Water	1		1	2		3		7
Vegetation				1		3		4
Cultural-Archaeology	1				1			2
Social	1				1			2
Economic	1	1						2
Legal and Administrative Concern	6	5	1	1		2		15
Like or Dis-like opinion					1	1		2
Non-descript	1	1	2	1				5
No-comment	9	1					1	11
TOTAL	22	8	5	5	3	11	1	55

1/ A single respondent could express a point in more than one interest element.
2/ Multiple replies to a single interest element by one respondent were recorded as separate responses.

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